Understanding Technology Acceptance: Phase 2 (Part 2) – Refining the Quantitative Model

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Executive Summary

The general research objectives of Phase II of the Technology Acceptance Project were four-fold: (1) to develop a battery of reliable and valid metrics to assess technology acceptance, (2) to test these metrics in the context of Deere-relevant products; (3) to use these preliminary data to test components of the qualitative model; and (4) to assess an initial quantitative model for Deere & Company products from different product categories that have been more or less successfully deployed in the marketplace. The results for objectives 1-3 were provided in December 2006:

> Van Ittersum, K., Rogers, W. A., Capar, M., Park, S., O'Brien, M. A., Caine, K. E., Parsons, L. J., & Fisk, A. D. (2006). *Understanding technology acceptance: Phase II* (HFA-TR-0604). Atlanta, GA: Georgia Institute of Technology, School of Psychology, Human Factors and Aging Laboratory.

The present report contains the complete analyses for the surveys we conducted to formally test an initial quantitative model of technology acceptance based on two Deere products. We collected data from golf course superintendents regarding Hybrid Riding Mowers and from farmers regarding Auto Guidance Systems. Chapters 1 & 2 present the formal quantitative tests (note there is an overlap from Chapter 5 of the previous report and Chapter 1 of the present report). Predictive validity of models was good but the model was not very parsimonious – that is, there were many variables in the model. Such a broad model limits our ability to understand acceptance and yields little managerial relevance. Moreover, the complexity of the model led to statistical challenges and some spurious effects (i.e., variable relationships that were not as predicted). In addition, some presumably important variables did not seem to influence acceptance (e.g., knowledge, costs). Therefore, we reassessed the model with the goal of identifying the causal relationships between variables. Chapter 3 provides the details of this updated model. The predictive validity of the adapted model was also good. The model was

more parsimonious and no spurious effects remained. Moreover, the model yielded managerially relevant insights. For example, the model suggests that improving *experience* with technology reduces the *perceived complexity* of the technology, which in turn improves the *perceived usefulness* of the technology, which increases *acceptance*. Similarly, improving the *instructions* regarding a technology improves the *perceived compatibility* of the technology, which in turn improves the *perceived usefulness* of the technology, which increases *acceptance*. Thus, in addition to making predictions about technology acceptance, the refined model provides guidance about how to influence consumers' technology acceptance.

Chapter 1 – Testing the Quantitative Model of Technology Acceptance: Hybrid Riding Mowers

To test our quantitative model among managerial decision makers, two technologies were selected in close collaboration with Deere & Company representatives. The technologies selected were Hybrid Riding Mowers and Auto Guidance Systems. The acceptance of Hybrid Riding Mowers was studied among a sample of superintendents of US golf courses. The acceptance of Auto Guidance Systems was investigated among a sample of US farmers.

Hybrid Riding Mowers

Method. To test the preliminary quantitative model for Hybrid Riding Mowers, we modified our questionnaire with respect to this technology. The questionnaire was designed to measure a wide variety of scales found in the literature (see Van Ittersum et al., 2006), as well as acceptance of Hybrid Riding Mowers. To control for the length of the questionnaire, and to increase the response rate, we combined some of these scales based on our initial test of these scales (see Van Ittersum et al.). All the scales included in this study are presented in Table 1.1 and 1.2 (to be discussed hereafter; see Appendix A for definitions of the constructs). In this questionnaire we randomized the order of items so that no two items of the same scale were placed consecutively.

In addition to the questionnaire, we prepared a cover letter and a consent form. The cover letter explained the objectives of the survey to the participants, why they were asked to participate, how they were contacted, the terms of privacy, how much it takes to complete the questionnaire, how to enter the sweepstakes, how to return the completed questionnaires, and whom to contact for their questions.

The questionnaire, along with other documents (consent form, cover letter, and sweepstakes entrance form), was sent to superintendents of 3000 golf courses in USA. The

names and contact information of the participants were retrieved from the National Golf Foundation database. The survey was distributed by the Survey Research Center at The University of Georgia.

Dependent Variables. The dependent variables were attitudinal acceptance, intentional acceptance, and behavioral acceptance. Table 1.1 shows the items we used to measure the dependent variables, and the response scales corresponding to these items.

Table 1.1. Measurement of Dependent Variables –Hybrid Riding Mower

Dependent Var.	Items	Response Scale	Reliability
Attitudinal Acceptance	Please indicate what your attitude is towards a hybrid riding mower, relative to a regular riding mower, by circling the appropriate responses.	1=Bad, 5=Good 1=Unfavorable, 5=Favorable 1=Negative, 5=Positive	.971
Intentional Acceptance	Please indicate what your intention is to buy a hybrid riding mower	1=No intention, 5=Strong intention 1=Unlikely, 5=Likely	.943
Behavioral Acceptance	Will you buy a hybrid riding mower	Yes-No	n/a

Independent Variables. Table 1.2 shows the items we used to measure the independent variables and the response scales corresponding to these items. For instance, ease of use, a technology characteristic, is measured with 3 items, and the response scale used is a 5 points Likert scale with 1=strongly disagree and 5=strongly agree.

Table 1.2 Measurement of Independent Variables – Hybrid Riding Mower

Construct	Items	Response Scale	Reliability
Technology Characteristics			
Ease of Use	Learning to operate a hybrid riding mower would be easy for us It would be easy for us to become skilful at using a hybrid riding mower We would find a hybrid riding mower easy to use	1=Strongly Disagree, 5=Strongly Agree	.724
Complexity	Using a hybrid riding mower would take too much time from our normal activities Working with a hybrid riding mower would be so complicated, it would be difficult to understand what is going on Using a hybrid riding mower would involve too much time doing mechanical operations	1=Strongly Disagree, 5=Strongly Agree	.667
Compatibility	Using a hybrid riding mower is compatible with all aspects of our work Using a hybrid riding mower fits well with the way we like to work Using a hybrid riding mower fits into our work	1=Strongly Disagree, 5=Strongly Agree	.757
Trialability	We can use a hybrid riding mower on a trial basis to see what it can do It is easy to try out the hybrid riding mower without a big commitment We have had opportunities to try out the hybrid riding mower	1=Strongly Disagree, 5=Strongly Agree	.615
Observability/Visibility	In my organization, one sees a hybrid riding mower on many courses The hybrid riding mower is not very visible in my organization	1=Strongly Disagree, 5=Strongly Agree	.690
Result Demonstrability	I have no difficulty telling others about the results of using a hybrid riding mower I believe I could communicate to others the consequences of using a hybrid riding mower The results of using a hybrid riding mower are apparent to me I would have difficulty explaining why using the hybrid riding mower may or may not be beneficial	1=Strongly Disagree, 5=Strongly Agree	.699
Voluntariness	The use of the hybrid riding mower is voluntary I am not required to use the hybrid riding mower Although it might be helpful, using a hybrid riding mower is certainly not compulsory in our job	1=Strongly Disagree, 5=Strongly Agree	.431

Table 1.2 Measurement of Independent Variables – Hybrid Riding Mower (-continued-)

Perceived Usefulness	Use of a hybrid riding mower can increase the effectiveness of performing tasks and activities Using a hybrid riding mower improves the quality of our work Using a hybrid riding mower increases our productivity If we use a hybrid riding mower, we will increase the quality of output	1=Strongly Disagree, 5=Strongly Agree	.807
Image	Golf courses which own a hybrid riding mower have more prestige than those who do not Golf courses which own a hybrid riding mower have a high profile Having a hybrid riding mower is a status symbol in my social environment	1=Strongly Disagree, 5=Strongly Agree	.830
Perceived Financial Cost	It would cost a lot to use a hybrid riding mower There are financial barriers to me using hybrid riding mower	1=Strongly Disagree, 5=Strongly Agree	.429
Newness	I consider hybrid riding mowers radically new products Adding hybrid technology to riding mowers is very innovative Hybrid riding mowers are radical new products	1=Strongly Disagree, 5=Strongly Agree	.790
User Characteristics			
Optimism	I prefer to use the most advanced technology available I like computer programs that allow me to tailor things to fit my own needs Technology makes me more efficient in my occupation	1=Strongly Disagree, 5=Strongly Agree	.679
Technology Anxiety	Technical support lines are not helpful because they don't explain things in terms I understand There is no such thing as a manual for a high-tech product or service that is written in plain language When I get technical support from a provider of a high-tech product or service, I sometimes feel as if I am being taken advantage of by someone who knows more than I do	1=Strongly Disagree, 5=Strongly Agree	.656
Innovativeness	I can usually figure out new high-tech products and services without help from others I enjoy the challenge of figuring out high-tech gadgets I find I have fewer problems than other people in making new technology work for me	1=Strongly Disagree, 5=Strongly Agree	.675

Table 1.2 Measurement of Independent Variables – Hybrid Riding Mower (-continued-)

Insecurity	I do not consider it safe giving out a credit card number over a computer I do not consider it safe to do any kind of financial business online I worry that information I send over the internet will be seen by other people	1=Strongly Disagree, 5=Strongly Agree	.797
Knowledge	I have a lot of knowledge about hybrid riding mowers I am very familiar with hybrid riding mowers	1=Strongly Disagree, 5=Strongly Agree	.895
Social Factors	My colleagues will be helpful in the use of a hybrid riding mower My colleagues will be very supportive of the use of a hybrid riding mower for our job In general, my colleagues will support the use of a hybrid riding mower	1=Strongly Disagree, 5=Strongly Agree	.820
Subjective Norm	I think that people who influence my behavior think that we should use a hybrid riding mower I think that people who are important to me think that we should use a hybrid riding mower	1=Strongly Disagree, 5=Strongly Agree	.702
Behavioral Control	We have the resources necessary to use a hybrid riding mower We have the knowledge necessary to use a hybrid riding mower In light of the resources, opportunities, and knowledge required to use a hybrid riding mower, it would be easy for us to use a hybrid riding mower	1=Strongly Disagree, 5=Strongly Agree	.708
Experience	We do not have much experience using hybrid riding mowers	1=Strongly Disagree, 5=Strongly Agree	n/a
Facilitating Conditions	Specialized instruction concerning a hybrid riding mower will be available to us Assistance will be available to deal with system difficulties	1=Strongly Disagree, 5=Strongly Agree	.778
Affect	Operators would think using a hybrid riding mower is pleasant Operators would find working with a hybrid riding mower is fun Operators would like working with a hybrid riding mower	1=Strongly Disagree, 5=Strongly Agree	.665
Product Specific Anxiety	It scares me to think I could get into problems when using a hybrid riding mover I hesitate to use a hybrid riding mower for fear of ending up with problems that cannot be corrected A hybrid riding mower is somewhat intimidating to me	1=Strongly Disagree, 5=Strongly Agree	.798

Table 1.2 Measurement of Independent Variables –Hybrid Riding Mower (-continued)

Product Specific Items	**Cons** We will incur high maintenance costs when using a hybrid riding mower The electrical component of the hybrid riding mower will fail in a wet environment The replacement costs of failed parts of the hybrid riding mower will be high The hybrid riding mower yields quality output (r) The hybrid riding mower will cause maintenance problems **Pros** Using a hybrid riding mower will be good for the environment The hybrid riding mower will be less noisy The hybrid riding mower will reduce leak problems The benefits of using the hybrid riding mower will compensate for the increasing cost of fuel **Maintenance** Diagnosing problems with a hybrid riding mower will be easy We will have no problems in fixing the hybrid riding mower in case of a breakdown The hybrid riding mower will perform well in heavy tasks (e.g. thick, long, wet grass) Adopting the hybrid riding mower will require training of technical staff (r)	1=Strongly Disagree, 5=Strongly Agree	.741 .673 .684
Risk Attitude	I would be concerned about performance when using a hybrid riding mower I would be concerned about using a hybrid riding mower I would be willing to accept the risk of using a hybrid riding mower I would …	1=Strongly Disagree, 5=Strongly Agree 1=…not be willing to use a hybrid lawn mower, 5=…be willing to use a hybrid lawn mower	.714
Risk Perception	Relative to regular riding mower, using a hybrid riding mower would be… Using a hybrid riding mower would expose me to… I think using a hybrid riding mower would be risky	1=Risky, 5=Not risky 1=Much risk, 5=Not much risk 1=Strongly Disagree, 5=Strongly Agree	.836

In addition to these items, we asked the respondents questions about their current ownership and usage of and experience with Regular/ Hybrid Riding Mowers. For instance we asked how many Regular/ Hybrid Riding Mowers they had to understand their current acceptance of Regular and Hybrid Riding Mowers. Similarly, we asked how much experience they had with operating Regular/ Hybrid Riding Mowers.

We asked demographic questions about their organization and themselves, such as the location, terrain and quality of the golf course, the education level and position of the respondent, and the degree of influence the respondent has on riding mower purchase decisions. The details of the questionnaire can be found in Appendix B.

Before discussing the results, we will shortly describe the sample of superintendents. In total 212 superintendents (98.6% male) responded to the survey (response rate = 7.6%).[1] The average age of the superintendents was 45.6 years (range 25 – 74 years) with an average of 21.3 years (range 2 – 56 years) of work experience in the golf industry. Most of the superintendents were assistant superintendents prior to this job (30.2%) or superintendents at other golf courses (47.3%).

The superintendents worked at golf courses all over the US. The average number of regular holes was 18.3 holes (range 2 – 72 holes) with an average length of 8397 yards. The average reported staff size was 14.2 people (range 1 – 105 people), with an annual mechanics budget of $88,548 ($0 – $3000,000). 46.9% of the golf courses represented were tournament level golf courses. 53.1% were non-tournament level golf courses. One third of the golf courses were part of a housing development. Furthermore, 37.7% of the courses were private, 37.2 require a daily

[1] We conducted a follow-up with those who did not return the filled in survey. Superintendents who did not respond to the survey were approached via phone for about one hour a day for 14 business days. The call times varied from lunch time to early morning to late evening in an effort to collect the opinions of as many superintendents as possible. Approximately 150 superintendents were approached. Of those, 26 were able and willing to provide feedback. The two main responses were that they either never received the questionnaire or that they were simply too busy to fill one out (or completely forgot about it).

fee, and 14.5% represented a municipality. Most of the golf courses were open during spring, summer, and fall. 62.3% were also open during the winter.

47.3% of the courses reported having monthly dues. Of those golf courses that charged a fee (44.2%), 53.1% charge $50 or less, and 28.4% charge $100 or more.

The golf courses reported having an average of 10.1 regular mowers (range 2-35 mowers) with an average age of 5.7 years (range 1 – 20 years). The reported replacement age of regular mowers was 7.4 years (range 2 – 25 years).

One third of the superintendents were unaware of *Hybrid* Riding Mowers prior to the survey. Those who were aware reported that they learned about Hybrid Riding Mowers through the media (27.7%), the distributor (56.0%), and through other channels (16.0%; conference/shows, industry service, fellow superintendent, John Deere, magazine). The percentage of golf courses that actually owned a Hybrid Riding Mower was fairly low at 5.7% ($N = 12$), who bought their first Hybrid Riding Mower 12.8 months ago (range 1 – 24 months ago).

46.7% of the superintendents informed us that they would buy a Hybrid Riding Mower at some point in time. 22.7% told us they would never buy one. Those who mentioned that they would buy one, estimated they would buy one in about 26 months (range 1 – 120 months). Finally, 56.5% of the superintendents informed us that they would make the final decision regarding the purchase of a Hybrid Riding Mower. Another 39.2% claimed they would have a significant influence on this decision.

Results - Hybrid Riding Mower

Using OLS regression as well as logistic regression, we assessed the fit of the quantitative model. The results are shown in Table 1.3. We discuss each model (M1-M3) separately.

Table 1.3. Regression Results Hybrid Riding Mower

	Dependent Variables		
Independent Variables	**M1 Attitudinal Acceptance[a]**	**M2 Intentional Acceptance[a]**	**M3 Behavioral Acceptance[a]**
Attitudinal Acceptance		.408***	-.024
Intentional Acceptance			2.054***
Technology Characteristics			
Perceived Usefulness	.082	.164***	-.139
Ease of Use	.169**	.026	1.133
Complexity	-.099	.136	-1.371*
Compatibility	.252***	.089	2.241
Newness	.219***	.102	-.001
Newness2	.001	.063	.145
Trialability	.135**	.033	-.555
Observability/Visibility	.073	.097	.189
Result Demonstrability	.024	-.036	.555
Voluntariness	-.022	.070	.042
Technology Specific			
Cons	-.107	-.095	.253
Pros	.018	-.022	-.439
Maintenance	.072	.055	.324
User Characteristics			
Risk perception	-.061	.003	-.930
Risk attitude	.149	-.082	1.257
Risk attitude x Perc.	.034	-.128**	-.621
Technology Anxiety	-.054	.095	-.783
General Anxiety	-.153**	.010	-1.481*
Optimism	-.146**	-.038	-1.400**
Innovativeness	.150**	.054	-.606
Insecurity	.046	-.072	-.680
Image/Prestige	.024	-.072	-.091
Social Support	.256***	.079	1.226
Social Force	.016	.020	.322
Facilitating Conditions	-.025	.099	1.142*
Behavioral Control	.149*	.118	-.699
Knowledge	-.036	.128*	1.124*
Experience	-.014	-.041	-.046
Affect	-.065	-.045	1.140
Financial Cost	-.092*	-.093	-.852
Gender	-.071	-.028	-4.223**
Age	-.191**	-.090	-.009
Years of experience	.184***	.030	-.039
Course type	-.175***	.069	-.659
R-square	.552	.532	.802
F-value	4.889	5.659	

[a] Attitudinal and Intentional acceptance results are based on OLS. Behavioral acceptance results are based on logistics regression. Hence, the path-coefficients cannot be compared. * $p < .10$, ** $p < .05$, *** $p < .01$ (two-tailed)

M1: *Attitudinal Acceptance.* The *ease of use*, *compatibility*, *newness*, and *trialability* of the technology influenced attitudinal acceptance. More favorable perceptions of the *ease of use, the compatibility, the newness, and the trialability* of Hybrid Riding Mowers led to a more favorable attitude towards accepting Hybrid Riding Mowers. Furthermore, superintendents' *general anxiety* and *optimism* with regards to technologies negatively influenced attitudinal acceptance. *Innovativeness* on the contrary positively influenced attitudinal acceptance. *Social support* and *behavioral control* also positively influenced attitudinal acceptance. Finally, age negatively and years of experience positively influenced attitudinal acceptance. Also, superintendents at private golf courses had a more favorable attitude towards Hybrid Riding Mowers that those at municipal golf courses. The overall fit of the model **M1** was modest (*R*-square = .552)

M2: *Intentional Acceptance.* In line with TRA (Theory of Reasoned Action), *attitudinal acceptance* positively influenced intentional acceptance. Next, in line with the TAM model, we found that the *perceived usefulness* significantly influenced intentional acceptance. With perceived usefulness, intentional acceptance increased. Finally, there was an effect of the interaction between *risk attitude* and *risk perception*. That is, the positive effect of risk attitude on intentional acceptance reduced with superintendents' perceptions of the risk probabilities involved in operating Hybrid Riding Mowers. The overall fit of the model was modest (*R*-square = .532)

M3: *Behavioral Acceptance.* First, again in line with TRA, there was a significant impact of *intentional acceptance* of behavioral acceptance. The effects of technology and user characteristics remained limited to the effect of *complexity* and *general anxiety and optimism*. And, we found a significant positive effect of the *perceived facilitating conditions* and superintendents' *knowledge* about Hybrid Riding Mowers. Finally, a small significant effect was

found for *gender* – females were more likely to accept Hybrid Riding Mowers than males (note that there were only 3 females in the sample, 2 of which claim they will buy). The overall fit of the model was excellent (*R*-square = .802). More importantly, the percentage correctly predicted choices (yes/no acceptance) was high at 91.8%.

Predicting Actual Choice - Hybrid Riding Mower

The results of M3 were based on an intentional behavior measure – "Are you going to buy a Hybrid Riding Mower?" Next, we examined if and how well the independent variables predicted actual choice behavior by using actual behavior as the dependent variable ("Do you currently own a Hybrid Riding Mower?"). This posed a challenge for the Hybrid Riding Mower data because only 12 superintendents indicated that they currently owned one or more Hybrid Riding Mowers. Consequently, we did not have enough degrees of freedom to estimate our model. Instead of testing our model using logistics regression, we decided to simply compare the average scores on all our independent variable for those who currently owned a Hybrid Riding Mower and those who did not. The results are presented in Table 1.4.

Table 1.4. Comparing Owners of Hybrid Riding Mowers with Non-Owners

	Do Not Own Hybrid	**Do Own Hybrid**	***F*-value**
Attitudinal Acceptance	3.9	4.4	4.1**
Intentional Acceptance	2.9	4.3	16.3***
Perceived Usefulness	2.8	2.7	.2
Ease of Use	4.1	4.3	1.4
Complexity	2.1	1.8	2.1
Compatibility	3.5	4.3	10.7***
Newness	1.5	1.6	1.2
Newness2	.83	1.1	.5
Trialability	2.5	4.2	28.6***
Observability/Visibility	2.3	3.0	6.5***
Result Demonstrability	3.6	3.8	.8
Voluntariness	4.1	4.0	.01
Technology Specific			

Cons	.07	-1.1	15.7***
Pros	.02	-0.3	1.3
Maintenance	-.01	-.06	.01
User Characteristics			
Risk perception	3.9	4.5	6.9***
Risk attitude	3.8	4.5	7.3***
Risk attitude x Perc.	.04	.09	.02
Technology Anxiety	2.4	1.8	5.0**
General Anxiety	2.5	2.4	.2
Optimism	3.9	4.2	1.1
Innovativeness	3.4	3.6	.9
Insecurity	2.9	2.9	.00
Image/Prestige	2.1	1.8	1.3
Social Support	3.2	3.9	7.0***
Social Force	2.3	2.5	.6
Facilitating Conditions	3.4	3.7	1.2
Behavioral Control	3.4	4.2	9.2***
Knowledge	1.8	3.7	66.6***
Experience	0.9	2.6	22.3***
Affect	3.3	3.2	.2
Financial Cost	3.1	2.2	15.4***
Gender (males)	98.5%	100.0%	.2
Age	45.3	46.2	.1
Years of experience	21.2	22.1	.1
Course type			ns

* $p < .10$, ** $p < .05$, *** $p < .01$ (two-tailed)

Table 1.4 shows some interesting results. First, current owners of Hybrid Riding Mowers had more knowledge and experience than superintendents who did not own a Hybrid Riding Mower. Probably as a result of this difference in knowledge and experience, owners also had more favorable perceptions of the Hybrid Riding Mower. For instance, they had more favorable perceptions regarding the compatibility of Hybrid Riding Mowers, had less negative perceptions regarding the technology-specific characteristics, perceived less risk and had a more favorable attitude towards the risks at hand, and finally had a more favorable perception of the financial costs. There were also differences in perceived visibility and trialability (owners of systems could of course see them and try them).

Conclusions - Hybrid Riding Mower

As with the GPS cell phone research, and in line with the TAM model, the *perceived usefulness* and *ease of use* were two important variables influencing the acceptance likelihood of Hybrid Riding Mowers (either directly or indirectly through attitudinal acceptance). Also in line with the GPS cell phone research reported in Van Ittersum et al. (2006), we found that the *compatibility of the technology* – in this case the compatibility of the Hybrid Riding Mower with the current work style, influenced acceptance. With perceived compatibility, the acceptance likelihood increased. We also found an effect of newness – with perceptions of newness the acceptance likelihood increased.

Three use characteristics that significantly influenced acceptance were superintendents' *general anxiety* with regard to technology, their *optimism* about technologies (as with GPS cell phone research), and their *innovativeness*. The higher their anxiety, the lower the acceptance likelihood. We also found an effect of *optimism*. However, in this instance, optimism reduced acceptance likelihood (which goes against earlier research). We will elaborate upon these spurious effects later on in this report.

We also found that with perceived *social support* and *facilitating conditions*, the acceptance likelihood increased. That is, if superintendents believed they had the social and resource support to buy Hybrid Riding Mowers, they were more inclined to accept. It is interesting to note that social pressure, unlike we found among students in the GPS cell phone research, did not seem to affect acceptance among golf course superintendents.

As with the GPS cell phone research, we found a significant influence of superintendents' knowledge – the more *knowledgeable* they were about Hybrid Riding Mowers, the more likely they were to accept and buy one. Finally, we found that some demographics influenced

acceptance. For instance, while the acceptance likelihood was reduced as a result of age, work experience positively influenced acceptance. Also, there was a significant effect of course type. Superintendents at private golf course were more likely to accept Hybrid Riding Mowers than superintendents at golf courses that required daily fees or municipal golf courses.

Finally, there were some significant differences between current owners of Hybrid Riding Mowers and superintendents who did not own one. Some of the variables that were significantly different concern differences in knowledge and experience, which have a logical subsequent effect on some other variables. We will elaborate upon this later on in the report.

Chapter 2 – Testing the Quantitative Model of Technology Acceptance: Auto Guidance Systems

Auto Guidance Systems

Method. To test the quantitative model for Auto Guidance Systems, we modified our questionnaire with respect to this technology. The questionnaire was designed to measure a wide variety of scales found in the literature, as well as acceptance of Auto Guidance Systems. As with the Hybrid Riding Mower questionnaire, we combined some of these scales based on our initial test of these scales (see Van Ittersum et al., 2006). The randomization of the order of items was identical to Hybrid Riding Mower questionnaire. The details of this questionnaire can be found in Appendix C.

In addition to the questionnaire, we prepared a cover letter and a consent form. The cover letter explained the objectives of the survey, why they were asked to participate, how they were contacted, the terms of privacy, how much time it takes to complete the questionnaire, how to enter the sweepstakes, how to return the completed questionnaires, and whom to contact for their questions.

The questionnaire, along with other documents (consent form, cover letter, and sweepstakes entrance form), was sent to 3000 US farmers. The names and contact information of the participants were retrieved from a publicly available database. The survey was distributed by the Survey Research Center at The University of Georgia. Participants were offered the opportunity to enter a sweepstakes for a $20 gift certificate to be given to a total of fifty participants.

Dependent Variables. The dependent variables were again attitudinal acceptance, intentional acceptance, and behavioral acceptance. Table 2.1 shows the items we used to measure the dependent variables, and the response scales corresponding to these items.

Table 2.1. Measurement of Dependent Variables – Auto Guidance Systems

Dependent Var.	Items	Response Scale	Reliability
Attitudinal Acceptance	Please indicate what your attitude is towards auto guidance systems, relative to traditional steering, by circling the appropriate responses	1=Bad, 5=Good 1=Unfavorable, 5=Favorable 1=Negative, 5=Positive	.973
Intentional Acceptance	Please indicate what your intention is to buy an auto guidance system	1=No intention, 5=Strong intention 1=Unlikely, 5=Likely	.969
Behavioral Acceptance	Will you buy an auto guidance system	Yes-No	n/a

Independent Variables. Table 2.2 shows the items we used to measure the independent variables and the response scales corresponding to these items.

In addition to the items presented in Table 2.1 and Table 2.2, we asked the respondents questions about their current ownership and usage of, and experience with Auto Guidance Systems. For instance we asked how many Auto Guidance Systems they had to understand their current acceptance of this technology. Similarly, we asked how much experience they had with operating vehicles with an Auto Guidance System. In addition, we asked their attitude towards Auto Guidance Systems with different prices and different levels of accuracy by giving them nine options. With this question we aim to understand how the farmers valued different levels of accuracy. Moreover, we brought in universality and mobility functions and asked about their attitudinal/intentional/behavioral acceptance of universal or mobile Auto Guidance Systems. We also asked how important they thought these functions were, and how much more they would be willing to pay for these functions. Finally, we asked demographic questions about their organization and themselves, such as the location, geographic features and size of the farm, which crops are planted in the farm, the person who works/would work most with the Auto Guidance System, and the degree of influence the respondent has on Auto Guidance System purchase decisions. The details of these and other questions and scales can be found in Appendix C.

Table 2.2. Measurement of Independent Variables – Auto Guidance Systems

Construct	Items	Response Scale	Reliability
Technology Characteristics			
Ease of Use	Learning to operate an auto guidance system would be easy for me It would be easy for me to become skilful at using an auto guidance system I would find an auto guidance system easy to use	1=Strongly Disagree, 5=Strongly Agree	.854
Complexity	Using an auto guidance system would take too much time from my normal activities Working with an auto guidance system would be so complicated, it would be difficult to understand what is going on Using an auto guidance system would involve too much time doing mechanical operations	1=Strongly Disagree, 5=Strongly Agree	.692
Compatibility	Using an auto guidance system is compatible with all aspects of my work Using an auto guidance system fits well with the way I like to work Using an auto guidance system fits into my work	1=Strongly Disagree, 5=Strongly Agree	.865
Trialability	I can use an auto guidance system on a trial basis to see what it can do It is easy to try out the auto guidance system without a big commitment I have had opportunities to try out the auto guidance system	1=Strongly Disagree, 5=Strongly Agree	.645
Observability/Visibility	One sees auto guidance systems on many farms The auto guidance system is not very visible on my farm	1=Strongly Disagree, 5=Strongly Agree	.445
Result Demonstrability	I have no difficulty telling others about the results of using an auto guidance system I believe I could communicate to others the consequences of using an auto guidance system The results of using an auto guidance system are apparent to me I would have difficulty explaining why using the auto guidance system may or may not be beneficial	1=Strongly Disagree, 5=Strongly Agree	.687
Voluntariness	The use of the auto guidance system is voluntary I am not required to use the auto guidance system Although it might be helpful, using an auto guidance system is certainly not compulsory in my job	1=Strongly Disagree, 5=Strongly Agree	.563

Table 2.2. Measurement of Independent Variables – Auto Guidance Systems (-continued-)

Perceived Usefulness	Use of an auto guidance system can increase the effectiveness of performing tasks and activities Using an auto guidance system improves the quality of my work Using an auto guidance system increases my productivity If I use an auto guidance system, I increase the quality of output	1=Strongly Disagree, 5=Strongly Agree	.897
Image	Farmers who own an auto guidance system have more prestige than those who do not Farms who own an auto guidance system have a high profile Having an auto guidance system is a status symbol in my social environment	1=Strongly Disagree, 5=Strongly Agree	.726
Perceived Financial Cost	It would cost a lot to use an auto guidance system There are financial barriers to me using an auto guidance system	1=Strongly Disagree, 5=Strongly Agree	.451
Newness	I consider auto guidance systems a radically new technology Adding auto guidance systems to farm machinery is very innovative Auto guidance systems are radical new products	1=Strongly Disagree, 5=Strongly Agree	.628
User Characteristics			
Optimism	I prefer to use the most advanced technology available I like computer programs that allow me to tailor things to fit my own needs Technology makes me more efficient in my occupation	1=Strongly Disagree, 5=Strongly Agree	.558
Technology Anxiety	Technical support lines are not helpful because they don't explain things in terms I understand There is no such thing as a manual for a high-tech product or service that is written in plain language When I get technical support from a provider of a high-tech product or service, I sometimes feel as if I am being taken advantage of by someone who knows more than I do	1=Strongly Disagree, 5=Strongly Agree	.523
Innovativeness	I can usually figure out new high-tech products and services without help from others I enjoy the challenge of figuring out high-tech gadgets I find I have fewer problems than other people in making new technology work for me	1=Strongly Disagree, 5=Strongly Agree	.669

Table 2.2. Measurement of Independent Variables – Auto Guidance Systems (-continued-)

Insecurity	I do not consider it safe giving out a credit card number over a computer I do not consider it safe to do any kind of financial business online I worry that information I send over the internet will be seen by other people	1=Strongly Disagree, 5=Strongly Agree	.745
Knowledge	I have a lot of knowledge about auto guidance systems I am very familiar with auto guidance systems	1=Strongly Disagree, 5=Strongly Agree	.883
Social Factors	My colleagues will be helpful in the use of an auto guidance system My colleagues will be very supportive of the use of an auto guidance system for my job In general, my colleagues will support the use of an auto guidance system	1=Strongly Disagree, 5=Strongly Agree	.888
Subjective Norm	I think that people who influence my behavior think that I should use an auto guidance system I think that people who are important to me think that I should use an auto guidance system	1=Strongly Disagree, 5=Strongly Agree	.755
Behavioral Control	I have the resources necessary to use an auto guidance system We have the knowledge necessary to use an auto guidance system In light of the resources, opportunities, and knowledge required to use an auto guidance system, it would be easy for me to use an auto guidance system	1=Strongly Disagree, 5=Strongly Agree	.782
Experience	I do not have much experience using auto guidance systems	1=Strongly Disagree, 5=Strongly Agree	n/a
Facilitating Conditions	Specialized instruction concerning an auto guidance system will be available to me Assistance will be available to deal with system difficulties	1=Strongly Disagree, 5=Strongly Agree	.793
Affect	I would think using an auto guidance system is pleasant I would find working with an auto guidance system to be fun I would like working with an auto guidance system	1=Strongly Disagree, 5=Strongly Agree	.885
Product Specific Anxiety	It scares me to think I could get into problems when using an auto guidance system I hesitate to use an auto guidance system for fear of ending up with problems that cannot be corrected An auto guidance system is somewhat intimidating to me	1=Strongly Disagree, 5=Strongly Agree	.797

Table 2.2. Measurement of Independent Variables – Auto Guidance Systems (-continued-)

Product Specific Items	**Pros** The auto guidance system reduces operator fatigue, which allows for working longer hours The auto guidance system will reduce skips and overlaps, which reduces time and fuel expenses I will feel mentally and physically better at the end of a work day when using the auto guidance system The auto guidance system yields quality output Using an auto guidance system will decrease my costs associated with seed, fertilizer, and pesticides due to increased accuracy The benefits of using the auto guidance system will compensate for its cost The auto guidance system will require less labor The auto guidance system will perform well on heavy tasks (e.g. plowing) **Costs/Investments** Adopting the auto guidance system will require technical training I will incur high maintenance costs when using an auto guidance system The replacement costs of failed parts of the auto guidance system will be high The auto guidance system will cause installation problems The dependence of the auto guidance system on satellites makes it more vulnerable **Maintenance** I will have no problems in fixing the auto guidance system in case of a breakdown Diagnosing problems with an auto guidance system will be easy	1=Strongly Disagree, 5=Strongly Agree	.899 .717 .600
Risk Attitude	I would be concerned about performance when using an auto guidance system I would be concerned about using an auto guidance system I would be willing to accept the risk of using an auto guidance system I would … willing to use an auto guidance system	1=Strongly Disagree, 5=Strongly Agree 1=…not be 5=… be	.739
Risk Perception	Relative to operating vehicles without an auto guidance system, operating vehicles with an auto guidance system would be… Using an auto guidance system would expose me to… I think using an auto guidance system would be risky	1=Risky, 5=Not risky 1=Much risk, 5=Not much risk 1=Strongly Disagree, 5=Strongly Agree	.699

Before discussing the results, we will describe the sample of farmers. In total 266 farmers (98.5% male) responded to our survey (response rate = 9.1%).[2] The average age was 53.0 years (range 20 – 85 years) with an average of 34.7 years (range 1 – 70 years) of work experience in agriculture. The farmers were from all over the US. The average farm size consisted of 2,917 acres (owned and rented) (range 350 – 40,080 acres). The farmers in our sample employed an average of 2.0 full time employees (range 0 – 45 employees) and 2.2 part-time employees (range 0 – 80 employees). The farmers in our sample grow a wide variety of crops. Soybeans, corn, beans, wheat, and hay (Alfalfa) were mentioned the most.

Most farmers in our sample were aware of Auto Guidance Systems (95.4%). They learned about it an average of 33.1 months ago (range 4 – 94 months ago). 97.1% of those aware of Auto Guidance Systems learned about them via the media. 30.1% learned about them via the distributor. 15.8% learned about Auto Guidance Systems via other channels (e.g., farm shows, neighbors). 30.5% (80) of the farmers claimed they own an average of 2.0 Auto Guidance Systems (range 1 – 9 systems). The average age of these Auto Guidance Systems was 1.5 years (range 0 – 4 years). These farmers further claim to actually use the system on an average of 2.7 vehicles (range 1 – 10 years). Across the entire sample, the farmers had an average of 3.2 vehicles that might be equipped with an Auto Guidance System. 58.8% of the farmer stated that they would buy in an average of 20.0 months (range 0 – 120 months). 83.4% of the farmers informed us that they make the final decision regarding the purchase of an Auto Guidance System, whereas 14.2% indicated that they had a significant influence on the final decision.

[2] We conducted a follow-up with those who did not return the filled in survey. Farmers who did not respond to the survey were approach via phone for about one hour a day for 14 business days. The call times varied from lunch time to early morning to late evening in an effort to collect the opinions of as many farmers as possible. Approximately 150 farmers were approached. Of those, 50 were able and willing to provide feedback. The two main responses were that they either never received the questionnaire or that they were simply too busy to fill one out (or completely forgot about it).

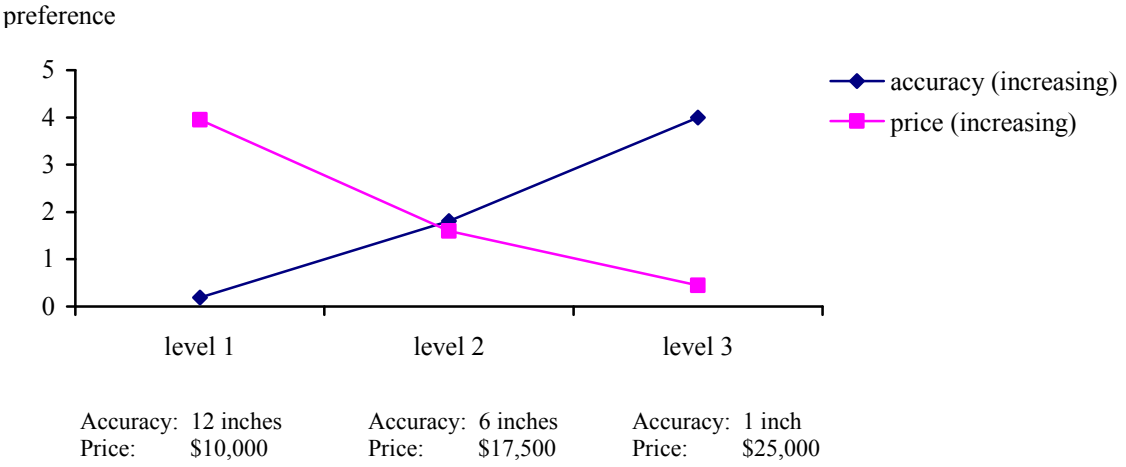
This research focuses on Auto Guidance Systems in general. We did collect some additional information about *universal* and *mobile* Auto Guidance Systems. First, 13.5% of the farmers claim to currently own an average of 1.7 *universal* Auto Guidance Systems (1 – 8 systems). They bought it 20.5 months ago (1 – 48 months ago). They use this system on 2.3 vehicles (1 – 8 vehicles). 29.3% of the farmers informed us that they plan to buy an average of 1.3 universal Auto Guidance Systems (1 – 10 systems). On a scale from 1 to 5 (1 = not important, 5 = very important), the farmers rate importance of the universality function as 3.2 (1 – 5). Their average self-reported willingness to pay for this function is $8,050. 9.8% of the farmers did not want to pay extra.

First, 19.1% of the farmers claim to currently own an average of 1.5 *mobile* Auto Guidance Systems (1 – 5), which they bought in the last 24.2 months (1 – 72). 89.4% claim that they use the mobility function. They use this system on 2.9 vehicles (1 – 6). They claim to move the system from one vehicle to another an average of 3.4 (0 – 15) times per year. 29.3% of the farmers informed us that they plan to buy an average of 1.3 universal Auto Guidance Systems (1 – 10).

On a scale from 1 to 5 (1 = not important, 5 = very important), the farmers rated importance of the universality function as 3.8 (range 1 – 5). Their average self-reported willingness to pay for this function was $9,408. 6.0% of the farmers did not want to pay extra.

We included a judgment task stimulating the farmers to trade off costs against accuracy of Auto Guidance Systems. By stimulating farmers to make trade-offs, insights into the optimal price-accuracy ratio can be obtained. Furthermore, the data allowed us to asses how important both attributes were to the farmers. We will start with the latter. We found that the relative importance of both attributes was about the same: 49.7% for accuracy versus 50.3% for price. Next, we graph the valuation of both attributes (see Figure 2.1). We found that the optimal combination of price and accuracy was about $17,500 with an accuracy of 6 inches.

Figure 2.1. Trade-off in valuation of price and accuracy of Auto Guidance Systems



Note that these analyses were done across farmers. Additional analyses may be conducted for specific farmer groups.

Results – Auto Guidance System

Next, using OLS regression analyses as well as logistics regression analyses, we examined our model. The results are presented in Table 2.3. As before, we will discuss the results for each model (M1-M3) separately.

Table 2.3. Regression Results Auto Guidance System

	Dependent Variables		
Independent Variables	**M1 Attitudinal Acceptance[a]**	**M2 Intentional Acceptance[a]**	**M3 Behavioral Acceptance[a]**
Attitudinal Acceptance		.363***	1.055
Intentional Acceptance			5.438**
Perceived Usefulness	.445***	.292***	1.372
Ease of Use	.017	.011	4.100
Complexity	-.171**	-.015	1.046
Compatibility	.001	.247***	2.730
Newness	-.053	-.060	-2.085
Newness2	.028	.024	-.453
Trialability	-.087	.068	2.586
Observability/Visibility	-.001	-.042	-4.496*
Result Demonstrability	.067	-.019	3.515*
Voluntariness	-.142**	.027	-5.533*
Technology Specific			
Pros	.262**	.057	1.374
Cons	-.034	-.091	1.816
Maintenance	-.076	-.061	1.915
User Characteristics			
Risk perception	-.131	-.043	-2.049
Risk attitude	-.014	.048	2.613
Risk attitude x Perc.	-.013	.020	3.450
Technology Anxiety	-.027	.087	4.770
General Anxiety	.014	.022	-.272
Optimism	.023	.110*	4.109
Innovativeness	.015	-.090	-1.099
Insecurity	.053	-.010	1.564
Image/Prestige	.116*	-.005	1.210
Social Support	.024	.139*	3.846
Social Force	.207*	.225***	-2.678*
Facilitating Conditions	-.063	-.052	-2.914*
Behavioral Control	.102	-.018	-1.581
Knowledge	.153	-.060	.005
Experience	.017	-.044	-.372
Affect	.001	.132	3.831
Financial Cost	.079	-.207***	-.530
Gender	.092	-.027	8.057
Age	.154	.139*	-.465
Years of experience	-.169*	-.106	.337
Farm size	.035	.056	-.001
R-square	.670	.823	.867
F-value	6.927***	13.667***	

[a] Attitudinal and Intentional acceptance results are based on OLS. Behavioral acceptance results are based on logistics regression. Hence, the path-coefficients cannot be compared. * $p < .10$, ** $p < .05$, *** $p < .01$ (two-tailed)

M1: *Attitudinal Acceptance.* We found that the *perceived usefulness*, *complexity*, and *voluntariness* influenced attitudinal acceptance. More favorable perceptions of the usefulness positively influenced attitudinal acceptance. Perceived complexity on the contrary reduced attitudinal acceptance. *Voluntariness* negatively influenced attitudinal acceptance (i.e., force stimulates acceptance). Besides these variables, we also found that one of the *technology-specific dimensions of perception* influences attitudinal acceptance. The perceived benefits associated with Auto Guidance Systems positively influenced attitudinal acceptance. Finally, we found two user characteristics to be predictive. First, was the perceived *prestige* associated with Auto Guidance Systems positively influenced attitudinal acceptance. Furthermore, *social pressures* influenced attitudinal acceptance. Finally, somewhat to our surprise, we found that number of years of experiences negatively influenced attitudinal acceptance. The overall fit of the model **M1** was high (*R*-square = .670)

M2: *Intentional Acceptance.* In line with TRA (Theory of Reasoned Action), *attitudinal acceptance* positively influenced intentional acceptance. Next, in line with the TAM model, we found that the *perceived usefulness* significantly influenced intentional acceptance. With perceived usefulness, intentional acceptance increased. Furthermore, we found that the *perceived compatibility* of Auto Guidance Systems influences intentional acceptance. We also found that perceptions of *social support* and *social force* influenced intentional acceptance. Farmers who perceived that there was social support as well as social pressure were be more inclined to buy an Auto Guidance System. Finally, we found a significant negative impact of the *financial costs* on intentional acceptance. The overall fit of the model was modest (*R*-square = .532)

M3: *Behavioral Acceptance.* First, again in line with TRA, we found a significant impact of *intentional acceptance* of behavioral acceptance. The main technology characteristics that

influenced farmers' decision to buy an Auto Guidance System directly were the *visibility* of the technology, *result demonstrability*, and *voluntariness*. The effect of the first factor is considered spurious – we would expect to find that with visibility, the behavioral acceptance increases (as has been shown in the literature). A comparable spurious effect was found for social force and facilitating conditions – both factors negatively influenced behavioral acceptance even though research suggests that with social force and facilitating conditions being in place, acceptance increases. We will get back to this issue later on. Despite some of these spurious effects, we found that the overall fit of the model was excellent (*R*-square = .867). More importantly, the percentage correctly predicted choices (yes/no acceptance) was high at 95.6%.

Predicting Actual Choice – Auto Guidance System

The results of M3 were based on an intentional behavior measure – "Are you going to buy a Auto Guidance System?" Next, we examined if and how well the independent variables predicted actual choice behavior by using actual behavior as the dependent variable ("Do you currently own an Auto Guidance System?"). As about one third of the farmers ($N = 80$) claimed they owned an Auto Guidance System, we were able to run logistic regression analyses. However, the model seemed to fit too well, resulting in statistical challenges. That is why we again decided to simply compare owners to non-owners. The results are presented in Table 2.4.

Table 2.4. Comparing Owners of Auto Guidance Systems with Non-Owners

	Do Not Own Auto Guidance Sys	Do Own Auto Guidance Sys	*F*-value
Attitudinal Acceptance	3.8	4.7	43.45***
Intentional Acceptance	2.7	4.6	92.7***
Perceived Usefulness	3.6	4.7	57.6***
Ease of Use	3.6	4.1	10.3***
Complexity	2.3	1.7	17.9***
Compatibility	3.0	4.2	72.9***
Newness	3.3	3.5	1.8
Newness2	-.08	-.05	.05
Trialability	2.7	4.0	67.3***
Observability/Visibility	2.7	3.9	56.9***
Result Demonstrability	3.3	4.2	53.9***
Voluntariness	4.0	3.6	8.6***
Technology Specific			
Cons	.24	-.20	6.6**
Pros	-.21	.50	22.1***
Maintenance	.10	-.14	1.8
User Characteristics			
Risk perception	3.8	4.2	13.6***
Risk attitude	3.8	4.6	34.0***
Risk attitude x Perc.	.001	.18	1.2
Technology Anxiety	2.6	2.1	10.7***
General Anxiety	2.8	2.7	.04
Optimism	3.5	4.1	26.8***
Innovativeness	3.1	3.3	3.4*
Insecurity	3.4	2.8	11.9***
Image/Prestige	2.3	2.6	2.5
Social Support	3.1	3.9	31.5***
Social Force	2.4	3.5	45.7***
Facilitating Conditions	3.4	3.8	5.5**
Behavioral Control	3.2	4.1	37.2***
Knowledge	2.2	3.8	101.7***
Experience	1.26	3.0	70.5***
Affect	3.7	4.3	20.5***
Financial Cost	3.9	3.2	18.3***
Gender (males)	97.8%	100.0%	ns
Age	53.0	51.5	.9
Years of experience	34.7	33.3	.7
Farm size	2,400	4,126	9.5***

* $p < .10$, ** $p < .05$, *** $p < .01$ (two-tailed)

As Table 2.4 shows, most of the variables examined were significantly different between current owners and non-owners of Auto Guidance Systems. One of the more notable differences

concerns farm size – this variable did not influence attitudinal, intentional, or behavioral acceptance.

Conclusions – Auto Guidance System

As with the Hybrid Mower survey and the GPS survey reported in Van Ittersum et al. (2006), and in line with the TAM model, we found that *perceived usefulness* is an important variable influencing the acceptance likelihood of Auto Guidance Systems (either directly or indirectly through attitudinal acceptance). Interestingly enough, the effect of the *ease of use* was limited, which suggests that this variable may be less critical when deciding about Auto Guidance Systems.

Also in line with the other studies, we found that the *compatibility of the technology* – in this case the compatibility of the Auto Guidance System with the current work style, influenced acceptance. With perceived compatibility, the acceptance likelihood increased. Furthermore, we found a negative effect of *complexity*. Some other critical variables were *the visibility, result demonstrability, and voluntariness*. However, the effects some of these were not in the expected direction. We will elaborate upon this hereafter. We found a fairly consistent effect of the *image* and *social force*, which suggests social factors do play a role among farmers (although they seemed to be of less relevance among golf course superintendents). Finally, when comparing the current owners and non-owners of Auto Guidance Systems, we found a large number of significant differences.

Chapter 3 – An Updated Model of Acceptance

Thus far we tested our model with three groups of decision makers regarding three unrelated technologies (GPS system reported in Van Ittersum et al., 2006; the hybrid mower and auto guidance technology reported herein). When examining the fit statistics of the different models as well as the correctly classified choices, the results are very satisfactory. That is, the fit statistics are high. Since one of the objectives of this project is to predict acceptance, these high fit statistics are great.

However, there were a number of reasons for us to reassess our model. First, the model was not very parsimonious. Despite the pre-study, that allowed us to reduce the number of independent variables, our model consisted of an extremely large number of independent variables. Ideally, one would like to predict with a model that consists of only a few variables. Besides the lack of parsimony, the large number of independent variables also caused some serious statistical problems that negatively influenced our ability to learn about how decision makers decide to accept a technology – an important second objective of this research. These spurious effects consisted of variables that influenced acceptance in a way that did not make theoretical sense. Furthermore, other variables did not seem to have any influence on acceptance even though the literature would suggest otherwise. One example was the marginal effects of decision makers' knowledge and experience with the technology on acceptance.

In light of all of this, we decided to reassess our model. First, we decided to eliminate some variables that have hardly been studied in the literature and were found not to influence acceptance in our samples. For instance, we decided to delete *newness* as a variable. Second, we decided to drop the technology-specific perceptions from the main model. Instead of including them in the main model, we use them to gain an understanding about what drives the perceived

usefulness and ease of use – two variables that have shown to have a high impact on acceptance (see Appendix D). Finally, we decided to drop the risk perception and risk attitudes. A closer look at these variables revealed that they were partly captured by perceived usefulness and ease of use.

Next, we rearranged the remaining variables as illustrated in Figure 3.1. First, we decided to start with the core of the TAM model – the perceived usefulness and ease of use. Next, we added the perceived costs to those two variables as this is not included by either one of them. Initially we added the *perceived demonstrability*, *visibility*, *compatibility*, *complexity* and *trialability* to the main model. However, we realized that most of these variables do not directly influence acceptance. For instance, why would *perceived complexity* directly influence acceptance? We believe that with *perceived complexity*, the *ease of use* and *perceived usefulness* are reduced. Likewise, why would the *perceived compatibility* directly influence acceptance? It only influences acceptance because it influences the *ease of use* and *perceived usefulness*. With this in mind, we decided to take these five characteristics out of the main model, and use them as determinants of perceived usefulness and ease of use (see Figure 3.1).

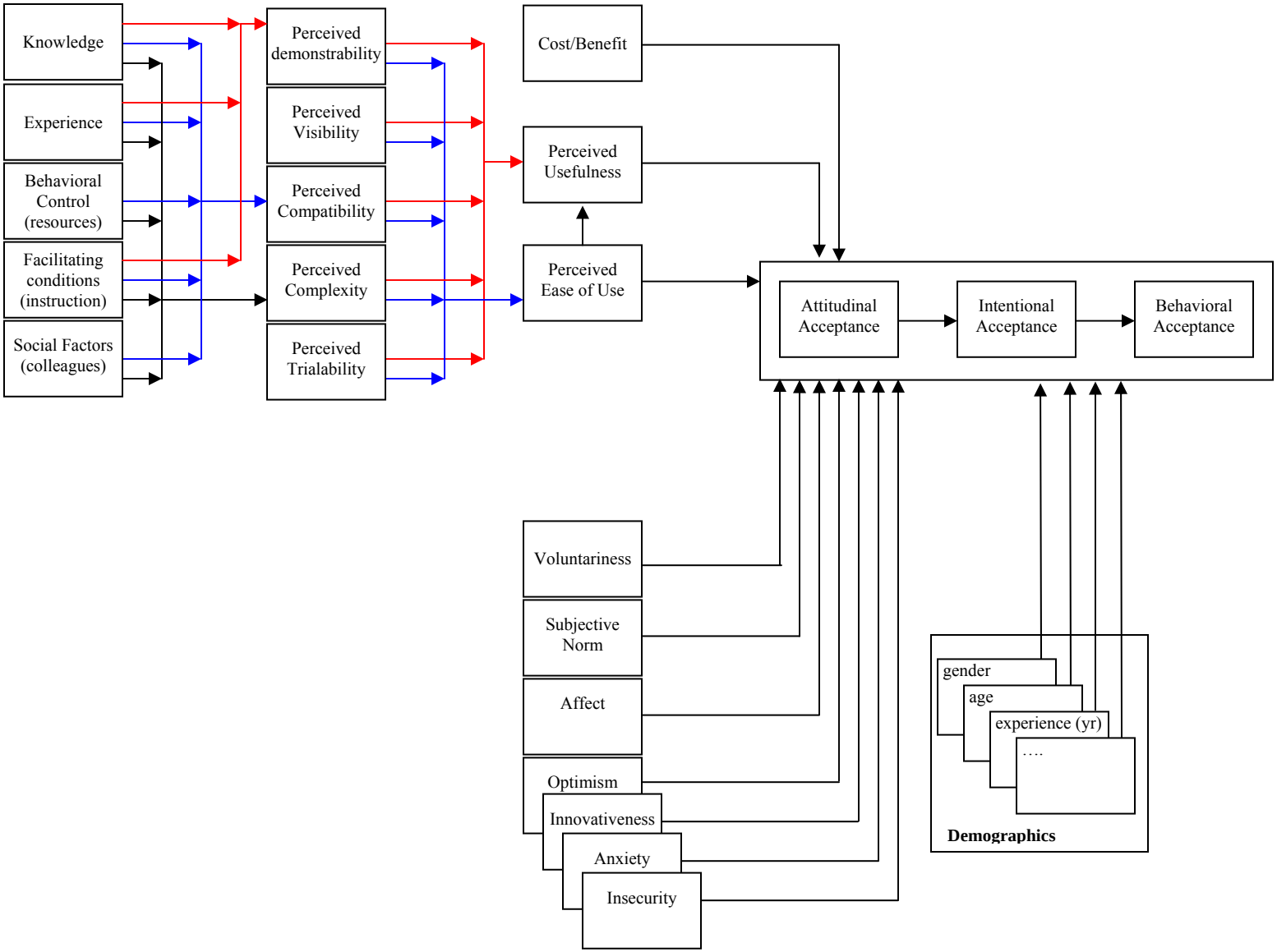
The next variables we considered were people's knowledge and experience, the perceived behavioral control, facilitating conditions, and social factors. The latter three components are all resource-based. The *behavioral control* refers to perceptions of available resources. The *facilitating conditions* refer to instructions and assistance available to use the technology. Finally, the *social resources* refer to the presence of supportive colleagues. The question was, how and why do these factors influences acceptance? We believe that these influence acceptance by reducing perceptions of complexity and improving perceptions of compatibility and demonstrability, which in turn influence ease of use and usefulness, which in turn influence

acceptance (see Figure 3.1).

Furthermore, we examined different user characteristics: voluntariness, subjective norm (social pressure), affect, optimism, innovativeness, discomfort, and insecurity. We believe that these user characteristics influence acceptance directly.

Based on the foregoing logic, we developed the model illustrated in Figure 3.1. We then re-analyzed our data for the Hybrid Riding Mower and the Auto Guidance System data.

Figure 3.1. An Updated Technology Acceptance Model



Results for Hybrid Riding Mower

The regression results of the adapted model are shown in Tables 3.1., 3.2., and 3.3. We start with the core of the model, aimed at predicting acceptance. We discuss the results across M1, M2, and M3.

Table 3.1. Regression Results Hybrid Riding Mower

	Dependent Variables		
Independent Variables	**M1 Attitudinal Acceptance[a]**	**M2 Intentional Acceptance[a]**	**M3 Behavioral Acceptance[a]**
Attitudinal Acceptance		.288***	.563
Intentional Acceptance			1.744***
Perceived Usefulness	.126*	.191***	.039
Ease of Use	.343***	.021	.918*
Financial Cost	-.153**	-.162***	-.418
User Characteristics			
Voluntariness	-.021	.096*	.110
General Anxiety	-.184***	.031	-.994**
Optimism	-.047	.029	-.569
Innovativeness	.099	.036	.306
Insecurity	.052	-.127**	-.541*
Social Force	.115*	.091	.606*
Affect	.026	-.072	.605
Gender	-.087	-.002	-1.183
Age	-.075	-.150**	.023
Years of experience	.085	.106	-.030
Golf course	-.134**	.015	-.110
R-square	.348	.441	.671
F-value	6.835***	9.366***	

[a] Attitudinal and Intentional acceptance results are based on OLS. Behavioral acceptance results are based on logistics regression. Hence, the path-coefficients cannot be compared. * $p < .10$, ** $p < .05$, *** $p < .01$ (two-tailed)

Consistent with the TAM model we found that the *perceived usefulness* and *ease of use* were two importance variables influencing acceptance. Plus, contrary to what found before, we now found a significant negative effect of the *perceived financial costs*. A closer look at the user

characteristics revealed a significant negative effect of superintendents' *anxiety* towards technologies as well as perceived insecurities about the safety of new technologies. Furthermore, we found that *social pressure* was a determining factor after all among superintendents (the original model did not demonstrate this effect).

The benefits of this more parsimonious model become clear. First, there were many fewer variables to consider. Second, no spurious effects were found (recall that M3 in the original model was largely driven by spurious effects). And, even though the overall fit statistics were somewhat reduced, the percentage of correctly predicted choices (yes/no acceptance) was still high at 85.9% (down from 91.8%).

Next, we examined the other two parts of the model. First, in line with expectations, we found that the *perceived usefulness* and *ease of use* were significantly influenced by the *perceived complexity, compatibility, and visibility*. Perceived *ease of use* was further influenced by *result demonstrability* (see Table 3.2). For instance, the *perceived complexity* negatively influenced *perceived ease of use*. Or, the *perceived compatibility* of Hybrid Riding Mowers positively influenced their *perceived usefulness*.

Table 3.2. Regression Results Hybrid Riding Mower

	Dependent Variables	
Independent Variables	**Perceived Usefulness**	**Perceived Ease of Use**
Ease of Use	-.048	
Complexity	-.184*	-.359***
Compatibility	.345***	.202***
Trialability	-.074	.091
Observability/Visibility	.182***	-.147***
Result Demonstrability	.109	.158**
R-square	.148	.385
F-value	5.777***	25.195***

* $p < .10$, ** $p < .05$, *** $p < .01$ (two-tailed)

Next, we examined if and how the *social support, facilitating conditions, behavioral control, knowledge and experience* influenced the *perceived compatibility, complexity and demonstrability*. We found that the *perceived compatibility* of Hybrid Riding Mowers was most strongly determined by perceptions of *social support* and perceived *facilitating conditions*. The *perceived complexity* in turn was negatively influenced by *facilitating conditions* – i.e., the *perceived complexity* reduces with more favorable perceptions of *facilitating conditions*. The *perceived demonstrability* was influenced by *facilitating conditions* and *knowledge*.

Table 3.3. Regression Results Hybrid Riding Mower

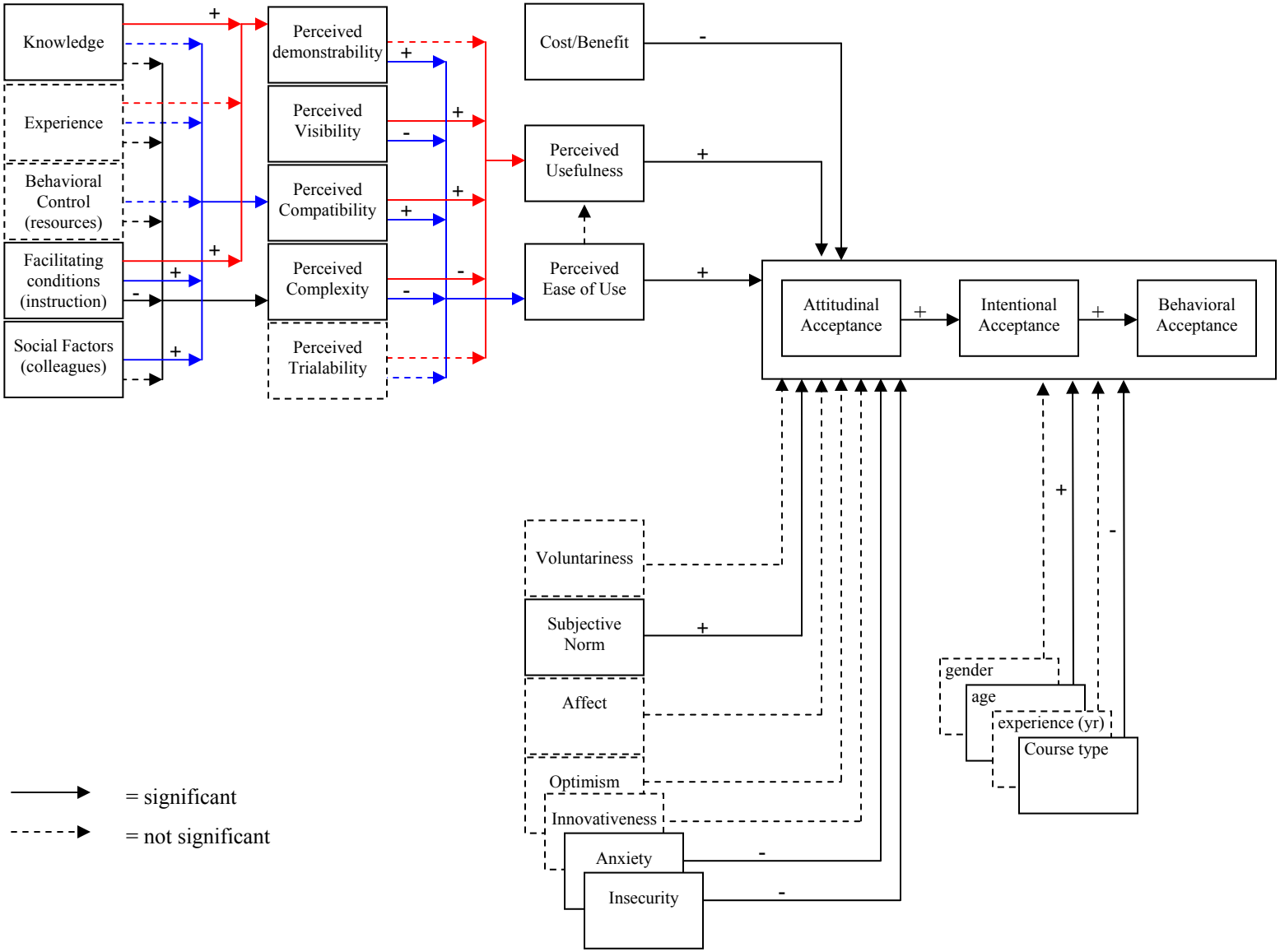
	Dependent Variables		
Independent Variables	**Perceived Compatibility**	**Perceived Complexity**	**Perceived Demonstrability**
Social Support	.289***	-.108	n/a
Facilitating Conditions	.176**	-.303***	.329***
Behavioral Control	.132	-.081	n/a
Knowledge	.035	-.094	.262***
Experience	.086	.012	.023
R-square	.279	.218	.215
F-value	15.217***	10.972***	18.064***

* $p < .10$, ** $p < .05$, *** $p < .01$ (two-tailed)

These results suggest that managers may improve the acceptance of Hybrid Riding Mowers by improving the perceived *social support, facilitating conditions and knowledge*, as these improve perceptions of *compatibility, complexity and demonstrability*, which in turn influence the *perceived usefulness* and *ease of use*, which influence acceptance.[3] Note that these kinds of conclusions could not have been drawn based on the original acceptance model. We summarize all the results in Figure 3.2.

[3] We believe that knowledge, experience, and facilitating conditions may be influenced via marketing actions. This may be more complex for behavioral control and social factors.

Figure 3.2. Final Results for the Hybrid Riding Mower



Results for Auto Guidance Systems

Table 3.4. Regression Results Auto Guidance System

	Dependent Variables		
Independent Variables	**M1 Attitudinal Acceptance[a]**	**M2 Intentional Acceptance[a]**	**M3 Behavioral Acceptance[a]**
Attitudinal Acceptance		.288***	.367
Intentional Acceptance			1.495***
Perceived Usefulness	.599***	.266***	.765
Ease of Use	.034	.034	.081
Financial Cost	-.014	-.208***	.311
User Characteristics			
Voluntariness	-.094*	.005	-.180
General Anxiety	.065	.057	.250
Optimism	.145**	.145**	.449
Innovativeness	.007	-.118*	-.480
Insecurity	.015	-.063	-.195
Social Force	-.077	.181***	-.195
Affect	.106	.051	.229
Gender	.080	.018	18.794
Age	.073	.149**	-.096**
Years of experience	-.128*	-.124*	.052
Farm size	.001	.058	.000
R-square	.649	.708	.693
F-value	18.925***	23.480***	

[a] Attitudinal and Intentional acceptance results are based on OLS. Behavioral acceptance results are based on logistics regression. Hence, the path-coefficients cannot be compared. * $p < .10$, ** $p < .05$, *** $p < .01$ (two-tailed)

Next, we examine if comparable insights may be obtained for Auto Guidance Systems (see Table 3.4). It is interesting to note that the *perceived usefulness* was an important determinant of acceptance. The perceived *ease of use* did not influence acceptance of Auto Guidance Systems. In line with expectations and the Hybrid Riding Mower, we found that the *financial costs* negatively influenced acceptance. Furthermore, we found that *voluntariness* negatively influenced acceptance – i.e, some force increases acceptance (cf., social force).

The benefits of this more parsimonious model become clear. First, there were many fewer

variables to consider. Second, no spurious effects were found. Although the overall fit statistics were again reduced, the percentage of correctly predicted choices (yes/no acceptance) was still high at 89.8% (down from 95.6%).

Next, in line with the Hybrid Riding Mower, we found that the *perceived usefulness* and *ease of use* were significantly influenced by the *perceived complexity* and *compatibility*. The *perceived complexity* reduced the *perceived usefulness* and *ease of use* while the *perceived compatibility* increased the *perceived usefulness* and *ease of use*. Furthermore, we found that *result demonstrability* positively influenced *perceived usefulness* and *ease of use*.

Table 3.5. Regression Results Auto Guidance System

	Dependent Variables	
Independent Variables	**Perceived Usefulness**	**Perceived Ease of Use***
Ease of Use	.027	
Complexity	-.131***	-.232***
Compatibility	.610***	.248***
Trialability	.059	.102
Observability/Visibility	.020	-.098
Result Demonstrability	.125**	.230***
R-square	.684	.339
F-value	79.125***	22.957***

** Remember that perceived ease of use does not influence acceptance of Auto Guidance Systems.*
* $p < .10$, ** $p < .05$, *** $p < .01$ (two-tailed)

Finally, we examined what drives farmers' perceptions of *compatibility, complexity, and demonstrability* and found that perceptions of *social support, behavioral control, and knowledge* and experience improved perceptions of *compatibility*. The *perceived complexity* in turn was improved (less complexity) by perceptions of *facilitating conditions and experience* (see Table 3.6). Finally, we found that the *perceived demonstrability* was positively influenced by

facilitating conditions and knowledge.

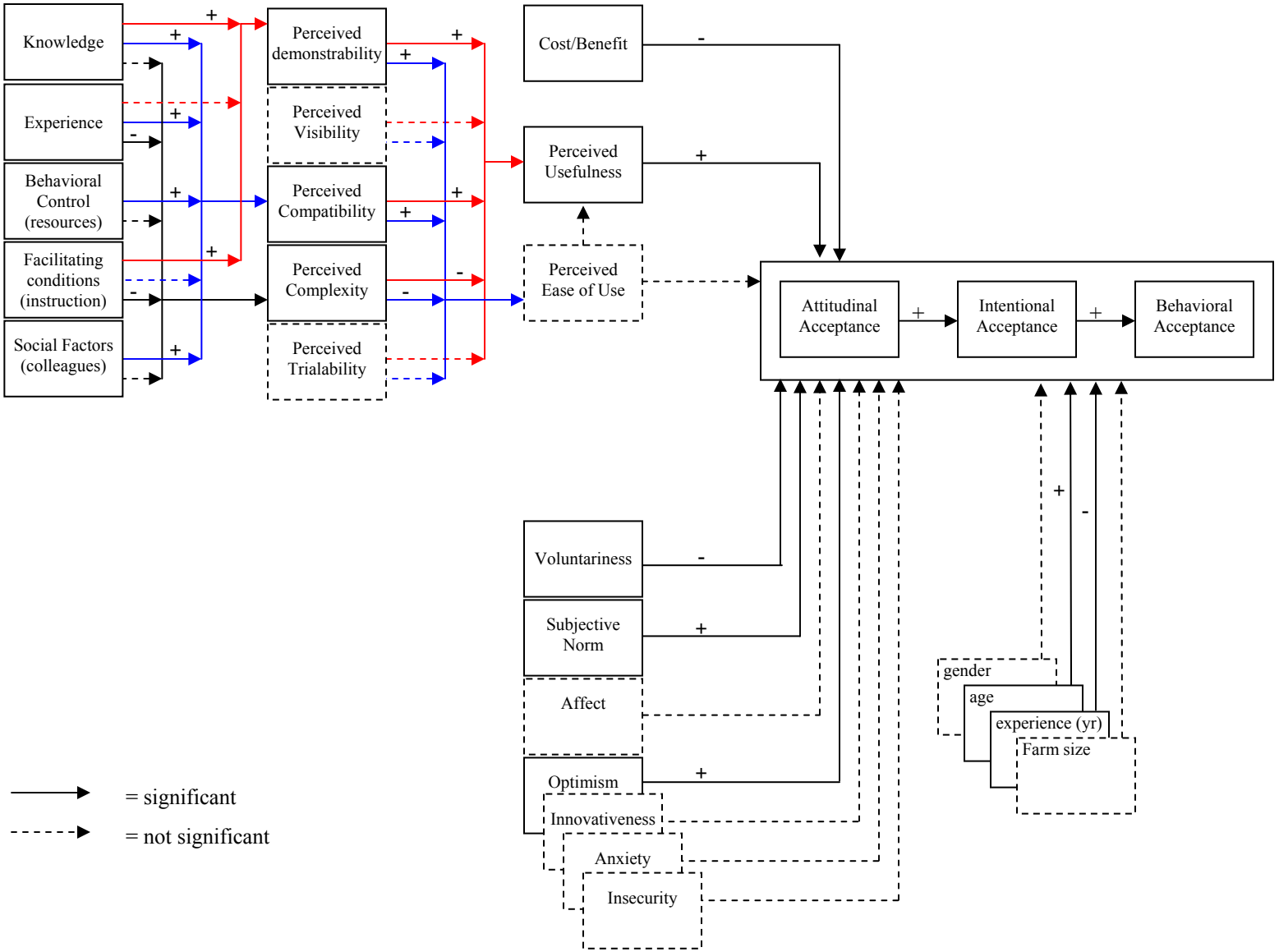
Table 3.6. Regression Results Auto Guidance System

	Dependent Variables		
Independent Variables	**Perceived Compatibility**	**Perceived Complexity**	**Perceived Demonstrability**
Social Support	.307***	-.131	n/a
Facilitating Conditions	-.011	-.235***	.278***
Behavioral Control	.164*	-.102	n/a
Knowledge	.239***	-.024	.478***
Experience	.152***	-.134*	.017
R-square	.493	.242	.393
F-value	42.771***	14.035***	51.566***

These results suggest that managers may improve the acceptance of Auto Guidance Systems by improving the farmers' *knowledge about* and *experience with* Auto Guidance Systems, among others. These in turn influence the *perceived usefulness* (and *ease of use*),[4] which influence acceptance.[5] Note that these kinds of conclusions could not have been drawn based on the original acceptance model. We summarized all results in Figure 3.3.

[4] Note that ease of use does not relate to acceptance of Auto Guidance Systems.
[5] We believe that knowledge, experience, and facilitating conditions may be influenced via marketing actions. This may be more complex for behavioral control and social factors.

Figure 3.3. Final Results for the Auto Guidance System



Summary and Conclusions

This report presents all the quantitative analyses conducted to examine the predictive validity of a Technology Acceptance Model that was constructed based on the results of Phase I of this research project. Based on a pre-study 1, we significantly reduced the number of questions that needed to be asked to be able to estimate our model (Van Ittersum et al. 2006). Next, we tested the model among a sample of superintendents of US golf courses with regard to a Hybrid Riding Mower. Furthermore, a sample of US farmers was approached regarding an Auto Guidance System. Extensive analyses revealed some interesting insights into the acceptance process among real managerial decision makers. However, the analyses also revealed some limitations of the original model. Besides some statistical anomalies, we realized that the variables in the model could be reorganized such that the value of the model increased at only a minimal cost with respect to the predictive validity. The data were reanalyzed and the final models presented in Figures 3.2 and 3.3.

We believe that this refined model provides insights into the variables that predict technology acceptance attitudes, intentions, and behaviors. This model will serve as the basis for the Phase III prediction of a new technology to be introduced by Deere & Company in the latter part of 2007 or early 2008. Moreover, the format of the model illustrates the causal relationships amongst the critical variables. Consequently, a second objective of Phase III is to investigate these causal relationships in more depth. The results of these studies will provide insights into how best to communicate with consumers to enhance their technology acceptance.

Appendix A – Definition of Constructs

Characteristic	Definition
Ease of Use	The degree to which the potential adopter expects a technological innovation to be free of effort (Davis, 1996; Moore & Benbasat, 1991)
Complexity	The degree to which an innovation is perceived as difficult to understand and use (Rogers, 2003)
Compatibility	The degree to which an innovation is perceived as being consistent with existing values, needs, and past experiences of potential adopters (Moore & Benbasat, 1991)
Trialability	The degree to which an innovation may be experimented with on a limited basis (Moore & Benbasat, 1991)
Observability & Visibility	The degree to which results of an innovation are visible to others (Rogers, 2003)
Result Demonstrability	The degree to which the benefits and utility of an innovation are readily apparent to the potential adopter (Moore & Benbasat, 1991)
Voluntariness	The degree to which use of an innovation is perceived as being voluntary or of free will (Moore & Benbasat, 1991)
Price	Price of technology
Usefulness	The extent to which a technology is expected to improve a potential adopter's performance (Davis, 1980, 1996)
Relative Advantage	The degree to which an innovation is perceived to be superior to current offerings (Rogers, 2003)
Image	The degree to which potential adopters believe the adoption of a technology will bestow them with added prestige in their relevant community (Moore & Benbasat, 1991)
Fun & Enjoyment	The extent to which using the technology results in enjoyment and perceived fun
Newness	The potential adopter's perception of the newness of a technology
Privacy	The perception of the privacy that the tech. provides
Network Effects	The effects of the number of customers already owning/using that technology
Value	The difference between perceived benefits and costs of a technology
Risk	Perceived risk involved in accepting a technology

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Privacy	The perception of the privacy that the tech. provides
Network Effects	The effects of the number of customers already owning/using that technology
Value	The difference between perceived benefits and costs of a technology
Risk	Perceived risk involved in accepting a tech
Demographics	
Age	Age of the (potential) user
Gender	Gender of the (potential) user
Income	Income level of the (potential) user
Education	Education level of the (potential) user
Training & Experience	Training about (using) the technology & experience with similar technologies
Knowledge & Involvement	Knowledge on the technology/ pre-existing technologies & involvement with the tech
Tenure	Tenure in the workforce
Psychographics	
Technology Readiness	People's propensity to embrace and use new technologies for accomplishing goals in home life and at work" (Parasuraman, 2000; p. 308)
Innovativeness	The predisposition to buy new and different products and brands rather than remain with previous choices and consumption patterns (Steenkamp, Hofstede, & Wedel, 1999)

Characteristic	Definition
Trust	Trust refers to trust in the technology provider
Privacy Concerns	Consumers' concerns about whether the information they provide to the technology provider by using its product/service will be protected from others, or whether the technology provider will take advantage of the information they gather through the use of its product/service
Technophobia	The fear of or dislike for new technology
Self-Efficacy	Judgment of one's ability to use a technology to accomplish a particular job or task (Venkatesh, Morris, Davis, and Davis, 2003)
Anxiety	Evoking anxious or emotional reactions when it comes to performing a behavior" (Venkatesh, Morris, Davis, and Davis, 2003)
Subjective Norm	The person's perception that most people who are important to him think he should or should not perform the behavior in question (Fishbein and Ajzen 1975, p. 302)
Dogmatism	The extent to which a person can react to relevant information on its own merits, unencumbered by irrelevant factors in the situation (Blake, Perloff, & Heslin, 1970)
Intrinsic Motivation	The perception that users will want to perform an activity "for no apparent reinforcement other than the process of performing the activity per se (Davis, Bagozzi, and Warshaw, 1992, p.1112)

HYBRID RIDING MOWER QUESTIONNAIRE

What do we mean by a hybrid riding mower?

A hybrid riding mower typically has a gas or diesel engine that not only powers the riding unit, but also runs an alternator. This alternator powers the cutting units independently of propulsion speed. The hybrid approach eliminates all the hydraulics in the cutting units.

1. How do you cut your ……. greens? ☐ Walk-behind ☐ Riding
……. fairways? ☐ Walk-behind ☐ Riding

2. Please answer the following questions regarding your company's riding mowers.

	Regular	**Hybrid**
a. How many of the following mowers does your organization have?	_____	_____
b. What is the average age of the riding mowers?	_____	_____
c. What is the age of the oldest riding mower you have?	_____	_____
d. What is the average age for replacement of a riding mower?	_____	_____

3. Were you aware of hybrid riding mowers prior to this survey?

☐ **No** ☐ **Yes, I first learned about hybrid riding mowers _____ months ago, through…**
☐ the Media
☐ the Distributor
☐ Other - namely ……

4. Do you currently own a hybrid riding mower?

☐ **No** ☐ **Yes, we bought our first hybrid riding mower _____ months ago**.

5. Please indicate how much experience you have with the following items.

	I have no experience				I have a lot of experience
Operating regular riding mower	1	2	3	4	5
Operating hybrid riding mower	1	2	3	4	5
Operating electrical equipment (e.g. hybrid cars)	1	2	3	4	5
Mower maintenance	1	2	3	4	5

6. Please indicate what your attitude is towards a hybrid riding mower, relative to a regular riding mower, by circling the appropriate responses.

Bad	1	2	3	4	5	**Good**
Unfavorable	1	2	3	4	5	**Favorable**
Negative	1	2	3	4	5	**Positive**

7. Please indicate what your intention is to buy a hybrid riding mower.

No intention	1	2	3	4	5	**Strong intention**
Unlikely	1	2	3	4	5	**Likely**

8. Will you buy a hybrid riding mower, and if so, how many will you buy?

☐ **No** ☐ **Yes, … I expect to buy _____ hybrid riding mowers as replacements**
… I expect to buy _____ hybrid riding mowers as additions

9. When do you expect you will have bought a hybrid riding mower?

_____ months from now ☐ **We will never buy one**

10. Below you find eleven moments in time, ranging from "This month" to "5 years from now." Please indicate for each moment the probability that you will have bought a hybrid riding mower by circling the appropriate response.

	I will not have bought one										**I will have bought one**
This month	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
6 months **from now**	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
1 year **from now**	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
1 ½ years **from now**	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
2 years **from now**	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
2 ½ years **from now**	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
3 years **from now**	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
3 ½ years **from now**	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
4 years **from now**	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
4 ½ years **from now**	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
5 years **from now**	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%

11. Please indicate for each statement about hybrid riding mowers to what extent you agree with it or feel it applies to you by circling the appropriate response (relative to regular riding mowers).

	Strongly Disagree				**Strongly Agree**
Use of a hybrid riding mower can increase the effectiveness of performing tasks and activities	1	2	3	4	5
I would be concerned about performance when using a hybrid riding mower	1	2	3	4	5
Using a hybrid riding mower increases our productivity	1	2	3	4	5
It would cost a lot to use a hybrid riding mower	1	2	3	4	5
Learning to operate a hybrid riding mower would be easy for us	1	2	3	4	5
I am not required to use the hybrid riding mower	1	2	3	4	5
We would find a hybrid riding mower easy to use	1	2	3	4	5
Using a hybrid riding mower would take too much time from our normal activities	1	2	3	4	5
In my organization, one sees a hybrid riding mower on many courses	1	2	3	4	5
Using a hybrid riding mower would involve too much time doing mechanical operations	1	2	3	4	5
Using a hybrid riding mower is compatible with all aspects of our work	1	2	3	4	5
I believe I could communicate to others the consequences of using a hybrid riding mower	1	2	3	4	5
Using a hybrid riding mower fits into our work	1	2	3	4	5
I consider hybrid riding mowers radically new products	1	2	3	4	5

	Strongly Disagree				Strongly Agree
The use of the hybrid riding mower is voluntary	1	2	3	4	5
We can use a hybrid riding mower on a trial basis to see what it can do	1	2	3	4	5
Using a hybrid riding mower improves the quality of our work	1	2	3	4	5
We have had opportunities to try out the hybrid riding mower	1	2	3	4	5
I have no difficulty telling others about the results of using a hybrid riding mower	1	2	3	4	5
Adding hybrid technology to riding mowers is very innovative	1	2	3	4	5
The results of using a hybrid riding mower are apparent to me	1	2	3	4	5
Using a hybrid riding mower fits well with the way we like to work	1	2	3	4	5
I would have difficulty explaining why using the hybrid riding mower may or may not be beneficial	1	2	3	4	5
Working with a hybrid riding mower would be so complicated, it would be difficult to understand what is going on	1	2	3	4	5
The hybrid riding mower is not very visible in my organization	1	2	3	4	5
It would be easy for us to become skilful at using a hybrid riding mower	1	2	3	4	5
Although it might be helpful, using a hybrid riding mower is certainly not compulsory in our job	1	2	3	4	5
Hybrid riding mowers are radical new products	1	2	3	4	5
If we use a hybrid riding mower, we will increase the quality of output	1	2	3	4	5
There are financial barriers to me using hybrid riding mower	1	2	3	4	5
It is easy to try out the hybrid riding mower without a big commitment	1	2	3	4	5

12. Please respond to the following statements regarding your beliefs about the performance of the hybrid riding mower (relative to regular riding mowers).

	Strongly Disagree				Strongly Agree
The hybrid riding mower yields quality output	1	2	3	4	5
The hybrid riding mower will cause maintenance problems	1	2	3	4	5
We will have no problems in fixing the hybrid riding mower in case of a breakdown	1	2	3	4	5
The replacement costs of failed parts of the hybrid riding mower will be high	1	2	3	4	5
Adopting the hybrid riding mower will require training of technical staff	1	2	3	4	5
We will incur high maintenance costs when using a hybrid riding mower	1	2	3	4	5
The benefits of using the hybrid riding mower will compensate for the increasing cost of fuel	1	2	3	4	5
The hybrid riding mower will perform well in heavy tasks (e.g. thick, long, wet grass)	1	2	3	4	5
The electrical component of the hybrid riding mower will fail in a wet environment	1	2	3	4	5
Diagnosing problems with a hybrid riding mower will be easy	1	2	3	4	5
The hybrid riding mower will reduce leak problems	1	2	3	4	5
The hybrid riding mower will be less noisy	1	2	3	4	5
Using a hybrid riding mower will be good for the environment	1	2	3	4	5

13. Considering the potential advantages and disadvantages of the hybrid riding mower, please circle the appropriate responses:

	Risky				**Not risky**
a. Relative to regular riding mower, using a hybrid riding mower would be…	1	2	3	4	5

	…not be willing to use a hybrid riding mower				**…be willing to** use a hybrid riding mower
b. I would …	1	2	3	4	5

	Much Risk				**Not much Risk**
c. Using a hybrid riding mower would expose me to…	1	2	3	4	5

	Strongly Disagree				**Strongly Agree**
d. I would be concerned about using a hybrid riding mower	1	2	3	4	5
e. I think using a hybrid riding mower would be risky	1	2	3	4	5
f. I would be willing to accept the risk of using a hybrid riding mower	1	2	3	4	5

14. The following statements are about your general thoughts and feelings regarding technology. Please indicate for each statement to what extent you agree with it.

	Strongly Disagree				**Strongly Agree**
I prefer to use the most advanced technology available	1	2	3	4	5
There is no such thing as a manual for a high-tech product or service that is written in plain language	1	2	3	4	5
Technology makes me more efficient in my occupation	1	2	3	4	5
I can usually figure out new high-tech products and services without help from others	1	2	3	4	5
I do not consider it safe to do any kind of financial business online	1	2	3	4	5
I find I have fewer problems than other people in making new technology work for me	1	2	3	4	5
Technical support lines are not helpful because they don't explain things in terms I understand	1	2	3	4	5
I like computer programs that allow me to tailor things to fit my own needs	1	2	3	4	5
When I get technical support from a provider of a high-tech product or service, I sometimes feel as if I am being taken advantage of by someone who knows more than I do	1	2	3	4	5
I do not consider it safe giving out a credit card number over a computer	1	2	3	4	5
I enjoy the challenge of figuring out high-tech gadgets	1	2	3	4	5
I worry that information I send over the internet will be seen by other people	1	2	3	4	5

15. The following statements are about your thoughts about the hybrid riding mowers, relative to regular riding mowers. Please indicate for each statement to what extent you agree with it or feel it applies to you by circling the appropriate response.

	Strongly Disagree				**Strongly Agree**
I have a lot of knowledge about hybrid riding mowers	1	2	3	4	5
My colleagues will be very supportive of the use of a hybrid riding mower for our job	1	2	3	4	5
I am very familiar with hybrid riding mowers	1	2	3	4	5
I think that people who influence my behavior think that we should use a hybrid riding mower	1	2	3	4	5
My colleagues will be helpful in the use of a hybrid riding mower	1	2	3	4	5
We have the knowledge necessary to use a hybrid riding mower	1	2	3	4	5
In general, my colleagues will support the use of a hybrid riding mower	1	2	3	4	5
Golf courses which own a hybrid riding mower have more prestige than those who do not	1	2	3	4	5
We do not have much experience using hybrid riding mowers	1	2	3	4	5
Having a hybrid riding mower is a status symbol in my social environment	1	2	3	4	5
We have the resources necessary to use a hybrid riding mower	1	2	3	4	5
Specialized instruction concerning a hybrid riding mower will be available to us	1	2	3	4	5
In light of the resources, opportunities, and knowledge required to use a hybrid riding mower, it would be easy for us to use a hybrid riding mower	1	2	3	4	5
I think that people who are important to me think that we should use a hybrid riding mower	1	2	3	4	5
Assistance will be available to deal with system difficulties	1	2	3	4	5
Golf courses which own a hybrid riding mower have a high profile	1	2	3	4	5

16. The following statements are about your feelings about the hybrid riding mowers, relative to regular riding mowers. Please indicate for each statement to what extent you agree with it or feel it applies to you by circling the appropriate response.

	Strongly Disagree				**Strongly Agree**
Operators would think using a hybrid riding mower is pleasant	1	2	3	4	5
It scares me to think I could get into problems when using a hybrid riding mover	1	2	3	4	5
Operators would find working with a hybrid riding mower is fun	1	2	3	4	5
I hesitate to use a hybrid riding mower for fear of ending up with problems that cannot be corrected	1	2	3	4	5
Operators would like working with a hybrid riding mower	1	2	3	4	5
A hybrid riding mower is somewhat intimidating to me	1	2	3	4	5

Please answer the following questions about your organization:

17. In which state of the country is your golf course located? _____

18. Which of the following best describes the location of your organization?

☐ **Desert** ☐ **Near coast** ☐ **Mountains** ☐ **None applicable**

19. Which time of the year is your golf course open? (Please select as many as needed.)

☐ **Spring** ☐ **Summer** ☐ **Fall** ☐ **Winter**

20. Please indicate which one(s) of the following best describe the terrain of your golf course.

☐ **Hilly** ☐ **Flat** ☐ **Woods** ☐ **Water** ☐ **Rock** ☐ **Sandy**

21. Please indicate the quality of your course. ☐ **Tournament level** ☐ **Non-tournament level**

22. Which description is most appropriate for your organization?

☐ **Golf course at housing development** ☐ **Separate golf course**

23. How would you classify your golf course? ☐ **Private** ☐ **Daily fee** ☐ **Municipality** ☐ **Other**

24. Do you charge monthly dues? ☐ **Yes** ☐ **No**

If **no**, do you charge fee? ☐ **Yes** ☐ **No**

If **yes**, how much is fee? ☐ ≤ $25 ☐ $26 – $50 ☐ $51 – $75 ☐ $76 – $100 ☐ > $100

25. Please indicate how many of the following holes your organization has and how many yards long these holes are (total yards).

Number of Holes	**Total yards**
_____ Regular holes	_____ yards
_____ Executive holes	_____ yards
_____ Par 3 holes	_____ yards

26. How much influence do the following people have regarding riding mower purchases?

	Not much influence				**Much influence**
Superintendent	1	2	3	4	5
Mechanical Staff	1	2	3	4	5
Operator	1	2	3	4	5
Others _____	1	2	3	4	5

27. What is the size of your maintenance staff? _____

28. What is your annual budget for mechanics? **$**_____

29. If a regular riding mower costs $30,000, how much are you willing to pay for a hybrid riding mower?

$_____

Please answer the following questions about yourself:

30. What is your current position in the organization? _____

31. Please indicate how much influence you have regarding the riding mower purchase for your organization.

- ☐ **I make the final decision.**
- ☐ **I do not make the final decision, but I have a significant influence on the final decision.**
- ☐ **I have some influence on the final decision, but others have more influence than I do.**
- ☐ **I do not have any influence on the final decision.**

32. What was your prior job position?

- ☐ **Mechanic**
- ☐ **Operator**
- ☐ **Assistant superintendent at the same golf course**
- ☐ **Superintendent at another golf course**
- ☐ **Assistant superintendent at another golf course**
- ☐ **Other _____**

33. How many years have you been working in the golf course industry? _____ **years**

34. Describe your educational history. Check as many as needed and please describe your major.

Level of education	**Major**
☐ No formal education	_____
☐ Less than high school graduate	_____
☐ High school graduate/GED	_____
☐ Vocational training	_____
☐ Some college/Associate's degree	_____
☐ Bachelor's degree (BA, BS)	_____
☐ Master's degree (or other post-graduate training)	_____
☐ Doctoral degree (PhD, MD, EdD, DDS, JD, etc.)	_____

35. What is your gender? ☐ **Female** ☐ **Male**

36. What is your age? _____ **years**

37. Please describe any factors that made you decide (not) to buy a hybrid riding mower.

……
……
……
……
……
……
……
……
……
……

Thank you for your participation!!

AUTO GUIDANCE SYSTEM QUESTIONNAIRE

What do we mean by an auto guidance system?

An auto guidance system is a technology that automatically steers farm machinery via Global Positioning Systems (GPS) satellites.

**** Different auto guidance systems are available on the market and different available systems have different features. We are less interested in specific features different systems may have. We are primarily interested in your opinion about the one thing that all auto guidance systems share – the ability to automatically steer farm machinery using GPS satellites. Most of the questions that you will be asked to answer deal with the auto guidance system. For instance, when we ask you whether were aware of auto guidance systems prior to this survey, we are interested in your awareness of any auto guidance system. Towards the end of the questionnaire, you will be asked some questions about specific features associated with some auto guidance systems.*

1. Were you aware of auto guidance systems prior to this survey?

☐ **No**

☐ **Yes, I first learned about auto guidance systems _____ months ago,**
through… ☐ the Media
☐ the Distributor
☐ Other - namely ……

2. Do you currently own an auto guidance system?

☐ **No** ☐ **Yes, I bought my first auto guidance system_____ months ago**.

If **Yes:**

a. How many auto guidance systems do you own?	_____ systems
b. What is the average age of your auto guidance systems?	_____ years

c. On how many vehicles do you actually use the auto guidance system? _____ vehicle(s)

3. How many vehicles do you own that might be equipped with an auto guidance system? _____ vehicles

4. Please indicate how much experience you have with the following items.

	I have no experience				**I have a lot of experience**
Operating vehicles without an auto guidance system	1	2	3	4	5
Operating vehicles with an auto guidance system	1	2	3	4	5
Installing auto guidance systems	1	2	3	4	5
Global Positioning Systems (GPS)	1	2	3	4	5

5. Please indicate what your attitude is towards auto guidance systems, relative to traditional steering, by circling the appropriate responses.

Bad	1	2	3	4	5	**Good**
Unfavorable	1	2	3	4	5	**Favorable**
Negative	1	2	3	4	5	**Positive**

6. Please indicate what your intention is to buy an auto guidance system.

No intention	1	2	3	4	5	**Strong intention**
Unlikely	1	2	3	4	5	**Likely**

7. Will you buy an auto guidance system, and if so, how many will you buy?

☐ **No** ☐ **Yes, … I expect to buy _____ auto guidance systems as replacements**
… I expect to buy _____ auto guidance systems as additions

8. When do you expect you will have bought an auto guidance system?

_____ months from now ☐ **I will never buy one**

9. Below you see eleven moments in time, ranging from "This month" to "5 years from now." Please indicate for each moment the probability that you will have bought an auto guidance system by circling the appropriate response.

	I will not have bought one										**I will have bought one**
This month	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
6 months from now	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
1 year from now	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
1 ½ years from now	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
2 years from now	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
2 ½ years from now	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
3 years from now	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
3 ½ years from now	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
4 years from now	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
4 ½ years from now	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
5 years from now	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%

10. Please indicate for each statement about auto guidance systems to what extent you agree with it or feel it applies to you by circling the appropriate response (relative to traditional steering).

	Strongly Disagree				**Strongly Agree**
Use of an auto guidance system can increase the effectiveness of performing tasks and activities	1	2	3	4	5
I would be concerned about performance when using an auto guidance system	1	2	3	4	5
Using an auto guidance system increases my productivity	1	2	3	4	5
It would cost a lot to use an auto guidance system	1	2	3	4	5
Learning to operate an auto guidance system would be easy for me	1	2	3	4	5
I am not required to use the auto guidance system	1	2	3	4	5
I would find an auto guidance system easy to use	1	2	3	4	5
Using an auto guidance system would take too much time from my normal activities	1	2	3	4	5
One sees auto guidance systems on many farms	1	2	3	4	5
Using an auto guidance system would involve too much time doing mechanical operations	1	2	3	4	5
Using an auto guidance system is compatible with all aspects of my work	1	2	3	4	5
I believe I could communicate to others the consequences of using an auto guidance system	1	2	3	4	5
Using an auto guidance system fits into my work	1	2	3	4	5
I consider auto guidance systems a radically new technology	1	2	3	4	5
The use of the auto guidance system is voluntary	1	2	3	4	5
I can use an auto guidance system on a trial basis to see what it can do	1	2	3	4	5
Using an auto guidance system improves the quality of my work	1	2	3	4	5

I have had opportunities to try out the auto guidance system	1	2	3	4	5
I have no difficulty telling others about the results of using an auto guidance system	1	2	3	4	5
Adding auto guidance systems to farm machinery is very innovative	1	2	3	4	5
The results of using an auto guidance system are apparent to me	1	2	3	4	5
Using an auto guidance system fits well with the way I like to work	1	2	3	4	5
I would have difficulty explaining why using the auto guidance system may or may not be beneficial	1	2	3	4	5
Working with an auto guidance system would be so complicated, it would be difficult to understand what is going on	1	2	3	4	5
The auto guidance system is not very visible on my farm	1	2	3	4	5
It would be easy for me to become skilful at using an auto guidance system	1	2	3	4	5
Although it might be helpful, using an auto guidance system is certainly not compulsory in my job	1	2	3	4	5
Auto guidance systems are radical new products	1	2	3	4	5
If I use an auto guidance system, I increase the quality of output	1	2	3	4	5
There are financial barriers to me using an auto guidance system	1	2	3	4	5
It is easy to try out the auto guidance system without a big commitment	1	2	3	4	5

11. Please respond to the following statements regarding your beliefs about the performance of the auto guidance system (relative to traditional steering).

	Strongly Disagree				**Strongly Agree**
The auto guidance system yields quality output	1	2	3	4	5
The auto guidance system will cause installation problems	1	2	3	4	5
I will have no problems in fixing the auto guidance system in case of a breakdown	1	2	3	4	5
Using an auto guidance system will decrease my costs associated with seed, fertilizer, and pesticides due to increased accuracy	1	2	3	4	5
I will feel mentally and physically better at the end of a work day when using the auto guidance system	1	2	3	4	5
The replacement costs of failed parts of the auto guidance system will be high	1	2	3	4	5
Adopting the auto guidance system will require technical training	1	2	3	4	5
I will incur high maintenance costs when using an auto guidance system	1	2	3	4	5
The benefits of using the auto guidance system will compensate for its cost	1	2	3	4	5
The auto guidance system will perform well on heavy tasks (e.g. plowing)	1	2	3	4	5
The dependence of the auto guidance system on satellites makes it more vulnerable.	1	2	3	4	5
Diagnosing problems with an auto guidance system will be easy	1	2	3	4	5
The auto guidance system will reduce skips and overlaps, which reduces time and fuel expenses	1	2	3	4	5
The auto guidance system will require less labor	1	2	3	4	5
The auto guidance system reduces operator fatigue, which allows for working longer hours	1	2	3	4	5

12. Considering the potential advantages and disadvantages of auto guidance systems, please circle the appropriate responses:

	Risky				**Not risky**
a. Relative to operating vehicles without an auto guidance system, operating vehicles with an auto guidance system would be…	1	2	3	4	5

	…not be willing to use an auto guidance system				**…be willing to** use an auto guidance system
b. I would …	1	2	3	4	5

	Much Risk				**Not much Risk**
c. Using an auto guidance system would expose me to…	1	2	3	4	5

	Strongly Disagree				**Strongly Agree**
d. I would be concerned about using an auto guidance system	1	2	3	4	5
e. I think using an auto guidance system would be risky	1	2	3	4	5
f. I would be willing to accept the risk of using an auto guidance system	1	2	3	4	5

13. The following statements are about your general thoughts and feelings regarding technology. Please indicate for each statement to what extent you agree with it.

	Strongly Disagree				**Strongly Agree**
I prefer to use the most advanced technology available	1	2	3	4	5
There is no such thing as a manual for a high-tech product or service that is written in plain language	1	2	3	4	5
Technology makes me more efficient in my occupation	1	2	3	4	5
I can usually figure out new high-tech products and services without help from others	1	2	3	4	5
I do not consider it safe to do any kind of financial business online	1	2	3	4	5
I find I have fewer problems than other people in making new technology work for me	1	2	3	4	5
Technical support lines are not helpful because they don't explain things in terms I understand	1	2	3	4	5
I like computer programs that allow me to tailor things to fit my own needs	1	2	3	4	5
When I get technical support from a provider of a high-tech product or service, I sometimes feel as if I am being taken advantage of by someone who knows more than I do	1	2	3	4	5
I do not consider it safe giving out a credit card number over a computer	1	2	3	4	5
I enjoy the challenge of figuring out high-tech gadgets	1	2	3	4	5
I worry that information I send over the internet will be seen by other people	1	2	3	4	5

14. The following statements are about your thoughts about auto guidance systems, relative to traditional steering. Please indicate for each statement to what extent you agree with it or feel it applies to you by circling the appropriate response.

	Strongly Disagree				**Strongly Agree**
I have a lot of knowledge about auto guidance systems	1	2	3	4	5
My colleagues will be very supportive of the use of an auto guidance system for my job	1	2	3	4	5
I am very familiar with auto guidance systems	1	2	3	4	5
I think that people who influence my behavior think that I should use an auto guidance system	1	2	3	4	5
My colleagues will be helpful in the use of an auto guidance system	1	2	3	4	5
We have the knowledge necessary to use an auto guidance system	1	2	3	4	5
In general, my colleagues will support the use of an auto guidance system	1	2	3	4	5
Farmers who own an auto guidance system have more prestige than those who do not	1	2	3	4	5
I do not have much experience using auto guidance systems	1	2	3	4	5
Having an auto guidance system is a status symbol in my social environment	1	2	3	4	5
I have the resources necessary to use an auto guidance system	1	2	3	4	5
Specialized instruction concerning an auto guidance system will be available to me	1	2	3	4	5
In light of the resources, opportunities, and knowledge required to use an auto guidance system, it would be easy for me to use an auto guidance system	1	2	3	4	5
I think that people who are important to me think that I should use an auto guidance system	1	2	3	4	5
Assistance will be available to deal with system difficulties	1	2	3	4	5
Farms who own an auto guidance system have a high profile	1	2	3	4	5

15. The following statements are about your feelings about the auto guidance systems, relative to traditional steering. Please indicate for each statement to what extent you agree with it or feel it applies to you by circling the appropriate response.

	Strongly Disagree				**Strongly Agree**
I would think using an auto guidance system is pleasant	1	2	3	4	5
It scares me to think I could get into problems when using an auto guidance system	1	2	3	4	5
I would find working with an auto guidance system to be fun	1	2	3	4	5
I hesitate to use an auto guidance system for fear of ending up with problems that cannot be corrected	1	2	3	4	5
I would like working with an auto guidance system	1	2	3	4	5
An auto guidance system is somewhat intimidating to me	1	2	3	4	5

Please answer the following questions about your organization:

16. In which of the 50 states in the USA is your farm located? _____

17. Please indicate which of the following geographic features apply to the location of your farm (Please check as many as needed).

☐ **Mountains** ☐ **Wooded Area** ☐ **River** ☐ **Hills** ☐ **Rocks**

18. What is the total size of your farm? _____ **Acres (owned and rented)**

19. How many employees are employed in your farm per year?

Full time _____ employees **Part time** _____ employees

20a. Who works most or would work most with the auto guidance system?

☐ **Owner of the farm**
☐ **Supervisor/Foreman**
☐ **Workers**
☐ **Other _____**

20b. How much influence does this person have on the purchase decision of an auto guidance system?

Not much influence 1 2 3 4 5 **Much influence**

21. Please indicate how much influence you have regarding the auto guidance system purchase for your farm.

☐ **I make the final decision.**

☐ **I do not make the final decision, but I have a significant influence on the final decision.**

☐ **I have some influence on the final decision, but others have more influence than I do.**

☐ **I do not have any influence on the final decision.**

22. Please indicate which crops you plant and how many acres of these crops are planted.

Crops	**Acres**
1.	
2.	
3.	
4.	
5.	
Total acres	

23. Please indicate for which activities you use or would use the auto guidance system, and for which ones you do not use or would never use the system.

I (would) use it for……	**I (would) NOT use it for……**
1.	1.
2.	2.
3.	3.
4.	4.
5.	5.

Example

Auto Guidance System:										
accuracy: xxxxxxx										
price: xxxxxxx										
negative										positive
0	10	20	30	40	50	**60**	70	80	90	100

24. Below you will find 9 different auto guidance systems.
These auto guidance systems are described on two aspects:
1. their accuracy (the systems reduce skips and overlaps to: 1 inch, 6 inches, or 12 inches)
2. their price (the systems cost $10,000, $17,5000, or $25,000)

You may assume that all nine auto guidance systems are equal on any other aspects that you can think of.

Please indicate your attitude towards *each* auto guidance system by circling the most appropriate response (0 = negative – 100 = positive) (see example right top corner).

Auto Guidance System 1:										
accuracy: 1 inch										
price: $10,000										
negative										positive
0	10	20	30	40	50	60	70	80	90	100

Auto Guidance System 2:										
accuracy: 6 inches										
price: $10,000										
negative										positive
0	10	20	30	40	50	60	70	80	90	100

Auto Guidance System 3:										
accuracy: 12 inches										
price: $25,000										
negative										positive
0	10	20	30	40	50	60	70	80	90	100

Auto Guidance System 4:										
accuracy: 1 inch										
price: $17,500										
negative										positive
0	10	20	30	40	50	60	70	80	90	100

Auto Guidance System 5:										
accuracy: 6 inches										
price: $25,000										
negative										positive
0	10	20	30	40	50	60	70	80	90	100

Auto Guidance System 6:										
accuracy: 12 inch										
price: $10,000										
negative										positive
0	10	20	30	40	50	60	70	80	90	100

Auto Guidance System 7:										
accuracy: 1 inch										
price: $25,000										
negative										positive
0	10	20	30	40	50	60	70	80	90	100

Auto Guidance System 8:										
accuracy: 6 inches										
price: $17,500										
negative										positive
0	10	20	30	40	50	60	70	80	90	100

Auto Guidance System 9:										
accuracy: 12 inches										
price: $17,500										
negative										positive
0	10	20	30	40	50	60	70	80	90	100

Please answer the following questions in light of the following information about possible features of an auto guidance system:

- A **universal** auto guidance system can be installed on different vehicles (but is not mobile).
- A **mobile** auto guidance system is universal *and* has a mobility function that allows *you* to move the system between vehicles.

25. Do you currently own a universal auto guidance system?

☐ **No** ☐ **Yes, I bought my first universal auto guidance system_____ months ago**.

If **Yes:**

a. How many universal auto guidance systems do you own	_____ systems
b. What is the average age of your universal auto guidance systems	_____ years
c. On how many vehicles do you actually use the universal auto guidance system	_____ vehicle(s)

26. Please indicate what your attitude is towards a universal auto guidance system, relative to an auto guidance system which is not universal, by circling the appropriate responses.

Negative	1	2	3	4	5	**Positive**

27. Please indicate what your intention is to buy a universal auto guidance system.

No intention	1	2	3	4	5	**Strong intention**

28. Will you buy a universal auto guidance system, and if so, how many will you buy?

☐ **No** ☐ **Yes _____ system(s)**

29. Do you currently own a mobile auto guidance system?

☐ **No** ☐ **Yes, I bought my first mobile auto guidance system_____ months ago**.

If **Yes:**

a. How many mobile auto guidance systems do you own	_____ systems
b. What is the average age of your mobile auto guidance systems	_____ years
c. Do you use its mobility function?	☐ **Yes** ☐ **No**
d. On how many vehicles do you actually use the mobile auto guidance system	_____ vehicle(s)
e. How often do you move the auto guidance system from one vehicle to another in a year?	_____ in a year

30. Please indicate what your attitude is towards a mobile auto guidance system, relative to an auto guidance system without mobility function, by circling the appropriate responses.

Negative	1	2	3	4	5	**Positive**

31. Please indicate what your intention is to buy a mobile auto guidance system.

No intention	1	2	3	4	5	**Strong intention**

32. Will you buy a mobile auto guidance system, and if so, how many will you buy?

☐ **No** ☐ **Yes _____ system(s)**

33. How important is the **universality** function to your decision to buy an auto guidance system?

Not important 1 2 3 4 5 **Very important**

34. How important is the **mobility** function to your decision to buy an auto guidance system?

Not important 1 2 3 4 5 **Very important**

35. If a regular auto guidance system costs $10,000, how much would you be willing to pay for a

…..universal auto guidance system?	$_____
…..mobile auto guidance system?	$_____

Please answer the following questions about yourself:

36. How many years have you been working in agriculture? _____ **years**

37. Please describe your educational background.
Check as many as needed and please describe your major (when applicable)

Level of education	**Major**
☐ No formal education	
☐ Less than high school graduate	
☐ High school graduate/GED	
☐ Vocational training	
☐ Some college/Associate's degree	
☐ Bachelor's degree (BA, BS)	
☐ Master's degree (or other post-graduate training)	
☐ Doctoral degree (PhD, MD, EdD, DDS, JD, etc.)	

38. What is your gender? ☐ **Female** ☐ **Male**

39. What is your age? _____ **years**

40. Please describe any factors that made you decide to buy or not to buy an auto guidance system.

……
……
……
……
……
……
……
……
……
……

Thank you for your participation!!

Appendix D – Technology-specific perceptions of perceived usefulness and ease of use

Hybrid mower

We examine if and two what extent the technology-specific perceptions can be summarized into a smaller number of underlying dimensions (using factor analyses). The results are shown in Table D.1.

Table D.1. Technology-specific Perceptions of Hybrid Lawn Mower

	Average score (1-5)	Costs	Benefits	Maintenance
We will incur high maintenance costs when using a hybrid riding mower	2.8	X		
The electrical component of the hybrid riding mower will fail in a wet environment	2.7	X		
The replacement costs of failed parts of the hybrid riding mower will be high	3.2	X		
The hybrid riding mower yields low quality output	1.7	X		
The hybrid riding mower will cause maintenance problems	2.6	X		
Using a hybrid riding mower will be good for the environment	4.1		X	
The hybrid riding mower will be less noisy	3.7		X	
The hybrid riding mower will reduce leak problems	4.2		X	
The benefits of using the hybrid riding mower will compensate for the increasing cost of fuel	3.2		X	
Diagnosing problems with a hybrid riding mower will be easy	2.9			X
We will have no problems in fixing the hybrid riding mower in case of a breakdown	3.4			X
The hybrid riding mower will perform well in heavy tasks (e.g. thick, long, wet grass)	3.4			X
Adopting the hybrid riding mower will require no training of technical staff	2.2			X

These results are based on factor analyses – analyses to explore the structure underlying decision makers' responses to such questions as their belief about hybrid lawn mowers.

We find that the technology-specific perceptions can be summarized with three factors: a costs factor, a benefits fact, and a maintenance factor. The first factor captures those believe about the

technology that involve different types of (potential) costs involved with using hybrid lawn mowers. The second factor captures all the potential benefits of the hybrid lawn mower. Finally, the third factor captures beliefs about the maintenance of the hybrid lawn mower. Additional regression analyses demonstrate that these three factors significant influence the perceived usefulness and ease of use of hybrid lawn mowers. For instance, the perceived costs negatively influence the perceived usefulness and ease of use. The benefits and favorable maintenance perceptions positively influence the perceived usefulness and ease of use.

Table D.2. Effect of Technology-specific perceptions of perceived usefulness and ease of use

	Dependent Variables	
Independent Variables	**Perceived Usefulness**	**Perceived Ease of Use**
Costs	-.135*	-.226***
Benefits	.164***	.395***
Maintenance	.148**	.189***
R-square	.067	.243
F-value	4.880***	21.834***

Auto Guidance System

We examine if and two what extent the technology-specific perceptions can be summarized into a smaller number of underlying dimensions (using factor analyses). The results are shown in Table D.3.

Table D.3 Technology-specific Perceptions of Auto Guidance Systmes

	Average score (1-5)	Benefits	Costs	Maintenance
The auto guidance system reduces operator fatigue, which allows for working longer hours	4.0	X		
The auto guidance system will reduce skips and overlaps, which reduces time and fuel expenses	4.3	X		
I will feel mentally and physically better at the end of a work day when using the auto guidance system	3.9	X		
The auto guidance system yields quality output	3.8	X		
Using an auto guidance system will decrease my costs associated with seed, fertilizer, and pesticides due to increased accuracy	3.8	X		
The benefits of using the auto guidance system will compensate for its cost	3.4	X		
The auto guidance system will require less labor	3.4	X		
The auto guidance system will perform well on heavy tasks (e.g. plowing)	3.5	X		
Adopting the auto guidance system will require technical training	3.3		X	
I will incur high maintenance costs when using an auto guidance system	2.6		X	
The replacement costs of failed parts of the auto guidance system will be high	3.6		X	
The auto guidance system will cause installation problems	2.6		X	
The dependence of the auto guidance system on satellites makes it more vulnerable.	3.1		X	
I will have no problems in fixing the auto guidance system in case of a breakdown	2.3			X
Diagnosing problems with an auto guidance system will be easy	2.6			X

These results are based on factor analyses – analyses to explore the structure underlying decision makers' responses to such questions as their belief about hybrid lawn mowers.

Like the perceptions of the hybrid mower, we find that the technology-specific perceptions can be summarized with three factors: a costs factor, a benefits fact, and a maintenance factor. The first factor captures those believe about the technology that involve different types of

(potential) costs involved with using hybrid lawn mowers. The second factor captures all the potential benefits of the hybrid lawn mower. Finally, the third factor captures beliefs about the maintenance of the hybrid lawn mower. Additional regression analyses demonstrate that these three factors significant influence the perceived usefulness and ease of use of hybrid lawn mowers. For instance, the perceived costs negatively influence the perceived usefulness. The benefits and favorable maintenance perceptions positively influence the perceived usefulness and ease of use.

Table D.4. Effect of Technology-specific perceptions of perceived usefulness and ease of use

	Dependent Variables	
Independent Variables	**Perceived Usefulness**	**Perceived Ease of Use**
Costs	-.125***	-.058
Benefits	.833***	.465***
Maintenance	.007	.171***
R-square	.709	.240
F-value	195.289***	25.331***

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